

中国科学院  
古生物研究所集刊

MEMOIRS  
OF THE  
INSTITUTE OF PALAEONTOLOGY

*Academia Sinica*

第二号

No. 2



科学出版社  
SCIENCE PRESS

1959

## 內 容 簡 介

古生物研究所集刊是中国科学院古生物研究所的不定期的刊物。 本期共刊登論文两篇：

1. “新疆天山南麓古生代地层”

主要是分析南疆各沉积单元性质；对庫魯克塔克、柯坪及西崑崙山区等地的古生代地层作了說明和討論，建立古生代地层系統。

2. “华北及东北崑山統三叶虫动物羣”

主要是从动物羣关系上証明了崑山統的时代，并描述了崑山統 9 个新属及 28 个新种三叶虫。

# 古生物研究所集刊 第2号

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◀ 1959 年 9 月 ▶

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Edited by the Institute of Palaeontology, Academia Sinica

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# 新疆天山南麓古生代地层

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## 一、緒 言

1957年5—10月間,为配合地質部13大队做地层古生物工作,我們赴新疆天山南部进行了为期半年的野外調查。我們的工作区域是庫魯克塔克及覺羅塔克地区(北緯 $41^{\circ}20'$ — $43^{\circ}$ 东經 $88^{\circ}$ — $91^{\circ}$ 之間);柯坪至烏什間地区(北緯 $40^{\circ}40'$ — $41^{\circ}12'$ 东經 $78^{\circ}38'$ — $80^{\circ}$ 之間);喀什、康苏和巴什索貢地区(位于北緯 $39^{\circ}$ — $40^{\circ}$ ,东經 $75^{\circ}$ — $77^{\circ}$ )以及西崑崙山地区(位于北緯 $36^{\circ}55'$ — $38^{\circ}$ ,东經 $76^{\circ}15'$ — $78^{\circ}$ 之間)。由于这些地区居民点少,水源缺乏,交通不便,供应上受到很大限制,因而未能在更多的地区測制更多的地层剖面。

新疆天山南部柯坪塔克区主要属于地台型沉积,断裂、褶皱形式簡單,多形成构造一致的单斜山脊,大致出露有相同的沉积岩系。中奥陶紀末期,有一显著的緩慢上升运动。上石炭紀开始发生規模庞大的海侵,形成了較厚的紡錘虫及腕足

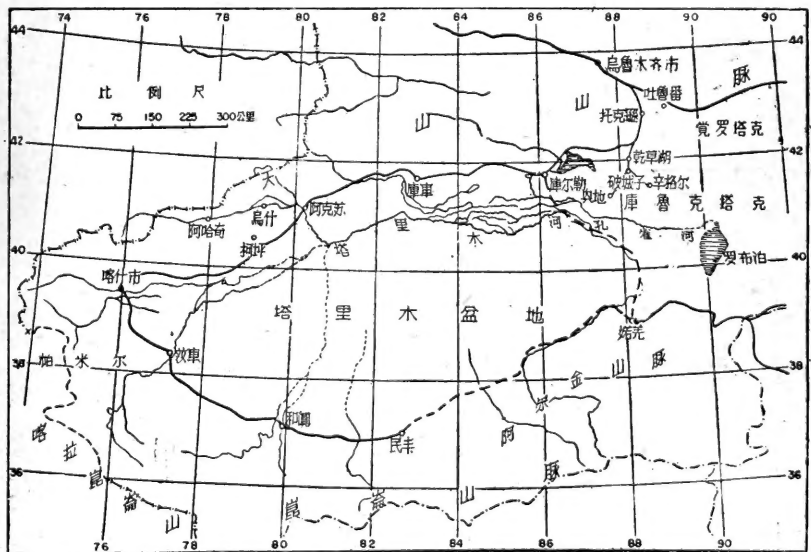


图1. 新疆天山南部地理位置图

类灰岩。庫魯克塔克区除西部及西南部属塔里木地块边缘地区仍为地台型沉积外,其他地区(包括覺羅塔克区),应属南天山地槽型沉积,喀什北部地区,按其沉积特点亦应属于南天山地槽型沉积,这些地区一般断裂多,褶皱強烈,火成岩活动劇烈,构造較复杂。靠近塔里木地台西南緣分布有古生代、中生代沉积岩系应属地台型沉积外,其他多为地槽型沉积,断裂特別发育,构造形态极其复杂,变质作用強烈,因而給时代的确定及地层的划分上带来了很大的困难。

历年来在新疆天山南部进行过地質調查的人很多,1928—1932年間,諾林(Norin)曾

在该区做过很多工作, 1941 年間格魯伯 (Gröber) 亦曾在該区进行过地質路線測量。1941—1943 年間苏联地質学家別良耶夫斯基与西尼村 (B. M. Синичин), 在天山南麓做了較詳細的工作, 对該区的地层划分上有很大的参考价值。1955 年新疆地質局在柯坪塔克区一带进行过矿区普查工作。1955—1957 年間地質部 13 大队在天山南部和西崑崙山地区进行了区域性的 20 万分之一比例尺的地質測量工作。新疆地質局 722 队在庫魯克塔克南部西山布拉克一带的工作, 对該区寒武紀地层的划分奠定了良好的基础。

以上前人这些工作成果, 对我們的工作起了很大的作用, 特别是近年来 13 大队的工作成果更是如此。在整个野外工作过程中又得到了 13 大队和新疆地質局等单位的大力支持和帮助, 在室内整理材料时, 本所赵金科、卢衍豪、王钰、楊敬之、穆恩之和盛金章等先生代为鑑定了本文中涉及的头足类、三叶虫、腕足类、苔蘚虫、笔石、鏤科等化石, 并对本文提供出宝貴的意見, 使我們的工作順利完成。为此謹向他們表示感謝。此外, 张务聰、徐宝瑞两同志代为描繪插图, 邹志学、邢佩芳、邹曼庆三同志分別代为打字, 也一併在此致謝。

## 二、地 层

为了便于叙述起見, 我們將文內所涉及的工作地区, 大致归納为三大区域(庫魯克塔克区、柯坪塔克区和西崑崙山区)分別介紹如下:

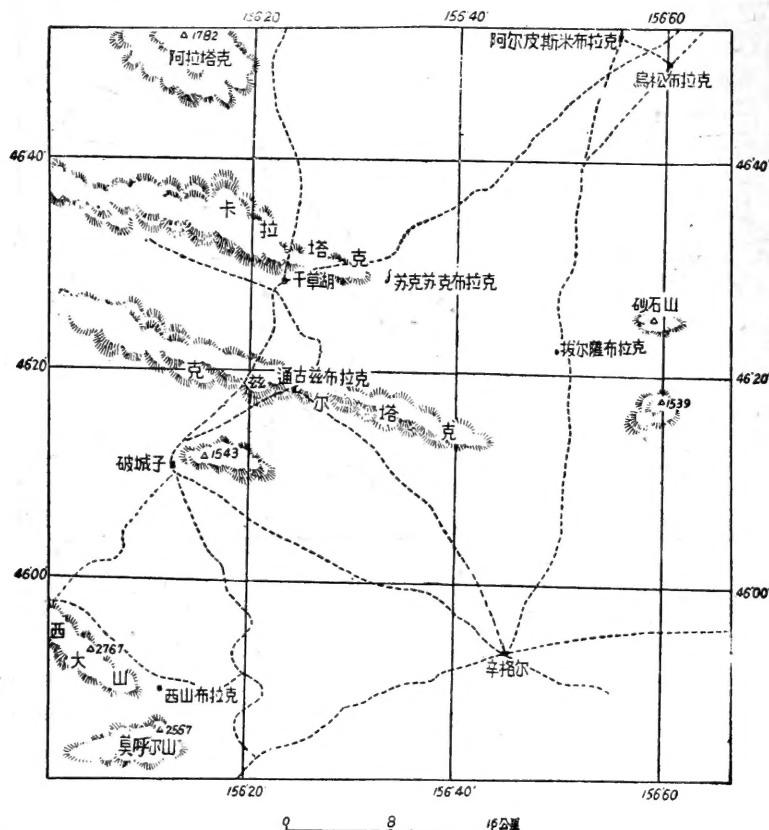


图2. 新疆庫魯克塔克区地理位置图

### (一) 寒武、奥陶紀 地层部分

#### 1. 庫魯克塔克区的 寒武、奥陶系

寒武系: 新疆天山南麓的寒武紀地层, 曾由諾林及西尼村等人, 作过較詳細的工作。諾林的寒武紀地层剖面的标准地点在庫魯克塔克西部的特尔沙克塔克及却尔恰克山一带。据丘迪生 (Gustaf T. Troedsson) 的报导 (1937 年中国古生物誌新乙种, 第 2 号总号 106 册), 該区仅发现有上寒武紀的动物羣, 其中以三叶虫为主, 大

部分种属与欧洲及我国南部、西南部几省的动物群关系密切,仅有个别的种属可与我国北部及东北地区进行对比。此次由于工作任务不同,我们未能去该区进行观察。最近胡树荣同志在“库鲁克塔克寒武纪地层问题”(地质月刊, 1958年7月)一文中对西库鲁克塔克地区的寒武纪地层,作了较详细的划分,我们此次的工作区是在库鲁克塔克区的西端,即破城子、兴地和辛格儿之间的西山布拉克<sup>1)</sup>一带,该地南面为莫呼尔山,北面为西大山,两者形成一个大的背斜构造,我们所测的寒武纪地层剖面在莫呼尔山北坡,今将该剖面自上而下介绍如下:

#### 上复地层——却尔恰克岩系(奥陶系)

##### ——整合接触——

#### 特尔沙克塔克统( $Cm_3^T$ )

- (19) 浅灰色厚层石灰岩,含三叶虫、腕足类化石碎片 20 米
- (18) 浅灰色厚层石灰岩夹少量浅灰色薄层石灰岩,顶部产三叶虫 *Pseudagnostus*, *Charchaia*, *Agnostus*, *Hedinaspis* 等 (SKS 075) 24.2 米
- (17) 深灰色厚层石灰岩与浅灰色薄层石灰岩互层,顶部产三叶虫 *Pseudagnostus*, *Hedinaspis* 等 (SKS 074) 14.4 米
- (16) 深灰色厚层石灰岩夹深灰色薄层石灰岩,顶部产三叶虫 *Charchaia* 等 (SKS 073) 15.8 米
- (15) 深灰色厚层石灰岩,风化面呈棕褐色,顶部产三叶虫碎片,保存不好,不易鉴定 (SKS 072) 4 米
- (14) 深灰色厚层石灰岩,不纯,质坚脆,易沿片理破裂,顶部产三叶虫 *Pseudagnostus* 等 (SKS 071) 16.4 米
- (13) 深灰色薄层石灰岩与深灰色厚层石灰岩成间互层,上部产三叶虫 *Lopnorites*, *Hedinaspis* 等 (SKS 070),中部产三叶虫 *Pseudagnostus*, *Proceratopyge* 等 (SKS 069) 22.2 米
- (12) 深灰色薄层石灰岩,上部产三叶虫 *Lopnorites* 等 (SKS 067),下部产三叶虫 *Charchaia* 等 (SKS 066) 6.7 米
- (11) 深灰色薄层石灰岩夹少量钙质页岩,自上而下共采得三叶虫化石 5 层: 1) *Lopnorites*, *Pseudagnostus*, *Charchaia* 等 (SKS 065); 2) 向下约 14 米处采得三叶虫 *Hedinaspis* 等 (SKS 064); 3) 向下约 24 米处采得 *Lopnorites* 等 (SKS 063); 4) 向下约 3.5 米处采得三叶虫 *Lopnorites* 等 (SKS 062); 5) 在本层底部采得三叶虫 *Lopnorites*, *Pseudagnostus* 等 (SKS 061) 92.1 米

#### 莫呼尔山统( $Cm_2^M$ )

- (10) 浅灰色薄层石灰岩夹钙质页岩,上部产三叶虫化石碎片,不易鉴定 (SKS 059—060); 下部产三叶虫 *Dorypyge* 等 (SKS 058) 16.8 米
- (9) 深灰色薄层石灰岩与钙质页岩互层,顶部产三叶虫 *Hypagnostus*, *Goniagnostus*, *Fuchouia* 等 (SKS 057) 25 米
- (8) 浅灰色薄层石灰岩夹棕褐色钙质页岩,产三叶虫 *Fuchouia* 等 (SKS 055—56) 18.1 米
- (7) 浅灰色薄层石灰岩,自上而下采得三叶虫三层: 1) *Goniagnostus* (SKS 054); 2) 向下约 15.5 米处采得 *Fuchouia*, *Peronopsis*, *Dorypyge* (SKS 053); 3) 向下 5 米处采得三叶虫 *Hypagnostus* (SKS 052) 31 米
- (6) 浅灰色薄层石灰岩夹少量深灰色中厚层石灰岩及钙质页岩。自上而下共采得三叶虫化石 6 层: 1) *Fuchouia*, *Peronopsis* (SKS 051); 2) 向下约 7.5 米处采得三叶虫

1) 布拉克——维吾尔族语,意即水泉。

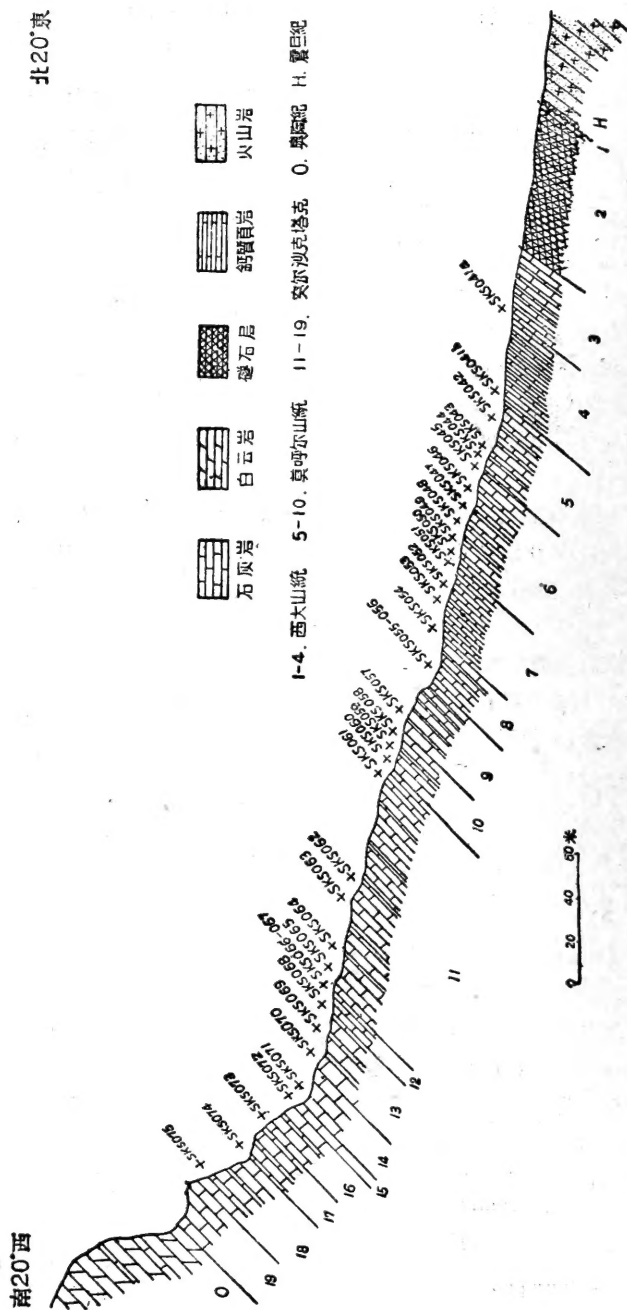


图3. 莫呼尔山寒武纪地层剖面示意图

*Dorypyge*, *Peronopsis* (SKS 050); 3) 向下 9.7 米处采得 *Lejopyge*, *Hypagnostus* (SKS 049); 4) 向下 3.9 米处采得三叶虫 *Peronopsis* (SKS 048); 5) 向下 3.6 米处采得化石 *Dorypyge*, *Fuchouia* (SKS 047); 6) 向下 4.3 米处采得三叶虫 *Fuchouia*, *Dorypyge* (SKS 046)

43 米

(5) 浅灰色薄层石灰岩与浅灰色中厚层石灰岩成間互层, 本层自上而下共采得 4 层三叶虫化石: 1) 上部采得 *Hypagnostus*, *Fuchouia* (SKS 045); 2) 向下 4.3 米处采得 *Hypagnostus*, *Goniagnostus* (SKS 044); 3) 向下 2 米处采得 *Goniagnostus*, *Ptychagnostus* (SKS 043); 4) 向下 10.5 米处采得 *Goniagnostus* (SKS 042)

31.60 米

#### 西大山統 (Cm<sub>1</sub>)

(4) 浅灰色薄层石灰岩夹少量钙质頁岩, 頂部采得三叶虫化石, 保存不好, 不易鑑定, 并采得少量腕足类 *Obolus* (*Westonia*) *lui* Sun (SKS 041 b)

35 米

(3) 浅灰色薄层石灰岩与钙质頁岩成間互层, 頂部采得三叶虫 *Palaeolenus* 等 (SKS 041 a)

30 米

(2) 黑色燧石层, 风化后表面呈土黃色, 在本层中未找到完整的化石, 仅发现有动物化石的破碎痕跡

60 米

(1) 磷块岩层

0.4 米

——假整合接触——

下伏地层——庫魯克塔克岩系(震旦系)

根据上述剖面可作一概說如下:

上寒武系——特尔沙克塔克統 (Cm<sub>1</sub><sup>T</sup>) 215.8 米

中寒武系——莫呼尔山統 (Cm<sub>1</sub><sup>m</sup>) 165.5 米

下寒武系——西大山統 (Cm<sub>1</sub><sup>i</sup>) 125.4 米

庫魯克塔克岩系为諾林 (Norin, R.) 所命名, 按我們所測剖面, 震旦系的岩性与諾林所述大同小异, 因此我們仍沿用此名。本岩系底部为冰磧层, 含細粒至巨块砾石之粗砂岩, 灰褐色, 石英顆粒較圓, 片理发育, 傾向北东 10°, 厚約 1,000 米, 中部夹一层厚約 3 米的輝綠岩脉, 上部出露約 10 米厚之火山岩两层, 冰磧层中石英脉貫穿其間。再上为土紅色或褐紅色火山岩, 厚約 30 米, 頂部为 3—5 米厚之浅黃色泥灰岩, 层面凹凸不平, 厚度变化較大, 这种現象应为磷块岩沉积以前受长期侵蝕风化的結果, 因此我們可以推断震旦系与寒武系之間曾存在一較长的侵蝕时期。

西大山統底部为磷块岩, 其厚度一般不超过 50 厘米, 橫向变化較大, 忽薄忽厚, 忽断忽續。中部为黑色燧石层, 向上逐漸变为薄层石灰岩, 本层傾向南西 30°, 傾角 40°—45°。在本剖面的西端相距約 3 里处, 在磷块岩上未有出露燧石层, 而出露一层鲕状石灰岩, 在这里我們找到了三叶虫 *Palaeolenus*, *Redlichia* 等; 小形古海綿 *Protospongia*、腕足类 *Obolus* sp. 等, 这些化石都是下寒武紀常見的种属, 因此它应相当于黑色燧石层, 同属下寒武紀。本統与下伏庫魯克塔克岩系的分界是以磷块岩的出現作为下寒武系的底部, 其上为燧石层。从厚度及岩性来看, 与胡树荣同志所述該区的下寒武系有所不同, 这种不同是由于剖面地点不同岩相变化的緣故呢? 还是其他原因呢? 值得进一步研究。

莫呼尔山統为浅灰色薄层石灰岩夹少量棕褐色钙质頁岩及中厚层石灰岩, 下部方解石脉貫穿其間, 片理发育, 岩层傾向南西 35°, 傾角 40°, 风化后呈淡黃色, 本层自下而上三叶虫化石非常丰富, 尤其在钙质頁岩中更易找到保存較完美的化石, 在本层中共采得化石



19层(SKS 042—060),根据化石鑑定(SKS 061)以上,应属上寒武紀,可惜(SKS 059—060)两层化石因保存不好,不易鑑定,故暫列入本統之頂部。根据野外观察本統与其上之特尔沙克塔克岩系下部同属一套岩层,其沉积环境和岩性非常相似,但上下两层所含三叶虫化石显然不同,因考虑到不同时期的类似沉积环境和岩性出现的可能性很大,所以主要以化石作为上、中寒武系的分界,这种情况在山东的寒武紀地层中以及华南的上部古生代地层中亦常見到。

特尔沙克塔克統为深灰色厚层石灰岩,夹少量薄层石灰岩夹层,向上逐漸变为深灰色厚层石灰岩。三叶虫化石主要产于下部的少量薄层石灰岩夹层中,本岩层傾向为南西 $25^{\circ}$ ,傾角 $53^{\circ}$ ,风化面呈棕黃色。本层从下到上共采得15层化石(SKS 061—SKS 075),因本統之頂部未采得完整化石,不易鑑定,与上复下奥陶紀地层的分界,还缺乏化石方面的証据,所以暫以岩性作为上寒武系与下奥陶系分界的主要根据,我們认为应从一大套块状白云岩的出露作为却尔却克岩系(下奥陶系)的底部。

却尔却克岩系整合于上寒武系特尔沙克塔克統之上,底部为灰白色厚层至块状白云岩,向上逐漸变为石灰岩与白云岩互层,偶夹少量薄层石灰岩,本层中未找到完整的化石,仅发现一些化石的破碎印痕,不能鑑定。

以上寒武紀地层的三个地层单位名称,上寒武系仍沿用諾林已命名的特尔沙克塔克統,但不包括其下部地层。另外两个地层单位都是此次新創立的名稱。

上述剖面中的三叶虫动物羣,絕大部分的种属与欧洲及我国南部和西南部地区的寒武紀动物羣非常接近,关系甚为密切,因此新疆庫魯克塔克区西部的寒武紀动物羣极大部分应属大西洋动物羣区(Atlantic Province)。

諾林的所謂上寒武紀“特尔沙克塔克統”的出露地点在我們所測剖面西面的特尔沙克塔克地区,相距約70里。按其所述剖面的下部約100米未找到化石,但岩性和我們所測剖面的中、下寒武系极其相似,仅厚度有所差別。我們推測該区亦有中、下寒武紀地层存在的可能。

庫魯克塔克区寒武紀地层多分布在西部及西南部,約在北緯 $40^{\circ}50'$ — $41^{\circ}35'$ ,东經 $87^{\circ}28'$ — $90^{\circ}$ 之間,包括土什克布拉克(Tüshakbulaq)、奥倫鉄盟图布拉克(Olontementubulaq)、辛格尔柯茲尔塔克(Singerqizil-tagh)、枯尔布其克塔克(Qurbanchiq-tagh)、却尔却克以及兴地以北等地,多与震旦系构成背斜构造,地层出露不全。

#### 奥陶系:

庫魯克塔克地区的奥陶系已被諾林命名为却尔却克系及土什克布拉克系。却尔却克在西大山之南約110里,在兴地东南約90里,該区出露有下、中奥陶紀地层,据諾林报导該区下奥陶紀地层主要为浅灰色薄层石灰岩和浅灰色鈣質及泥質頁岩互层,厚約10米,产腕足类: *Eoorthis* (?) sp.; 头足类 *Protobaltoceras quruqense* Troedsson, *P. holmi* Troedsson; 三叶虫 *Geragnostus kobayashii* Troedsson, *Trinodus suni* Troedsson, *Leignostus bexelli* Troedsson, *Symphysurus* (?) *anderssoni* Troedsson, *S.* (?) *wimani* Troedsson, *S.* (?) sp., *Asaphelina* (?) sp., *Norinia convexa* Troedsson, *N.* (?) sp., *Megalaspis* (?) sp., *Asaphus* sp., *Shumardia longifrons* Troedsson, *S.* (?) sp., *Harpides* sp.。該区中奥陶系呈整合复于下奥陶紀地层之上,其中、下部为綠色及灰色頁岩夹浅灰色薄层泥質石灰岩及

## 新疆天山南部庫魯克塔克区与华南区的寒武紀地层及动物羣的对比：

	庫魯克塔克区	华南区
上寒武系	特尔沙克塔克統 <i>Agnostus</i> <i>Pseudagnostus</i> <i>Lotagnostus</i> <i>Proceratopyge</i> <i>Hedinaspis</i> <i>Charchagia</i> <i>Lopnorites</i>	西阳山頁岩 (浙西) <i>Agnostus</i> <i>Pseudagnostus</i> <i>Lotagnostus</i> <i>Proceratopyge</i> <i>Hedinaspis</i> <i>Charchagia</i> <i>Olenus</i> <i>Westergardites</i> 华严寺石灰岩 (浙西) <i>Glyptagnostus</i>
中寒武系	莫呼尔山統 <i>Lejopyge</i> <i>Hypagnostus</i> <i>Goniagnostus</i> <i>Ptychagnostus</i> <i>Peronopsis</i> <i>Fuchouia</i> <i>Dorypyge</i>	楊柳崗石灰岩 (浙西) <i>Lejopyge</i> <i>Hypagnostus</i> <i>Goniagnostus</i> <i>Damesella(?)</i>
下寒武系	西大山統 <i>Palaeolenus</i> <i>Redlichia(?)</i>	滄浪節統 (滇东) <i>Palaeolenus</i> <i>Redlichia</i>

## 庫魯克塔克区的寒武紀地层

	张日东、俞昌民、陸麟黃、张達信 (1958)	西尼村 (1957)	諾林 (1937)
上寒武系	特尔沙克塔克統( $Cm_3^T$ ) 深灰色薄层石灰岩夾中厚层石灰岩，产 <i>Pseudagnostus</i> , <i>Charchagia</i> , <i>Agnostus</i> , <i>Hedinaspis</i> , <i>Lopnorites</i> 等。 215.8米	特尔沙克塔克統 暗灰色和黑色矽化石灰岩及鈣質頁岩。产 <i>Agnostus</i> , <i>Megalaspis</i> , <i>Raptagnostus</i> 700米	特尔沙克塔克統 上部暗灰色矽質灰岩夾鈣質頁岩，下部暗灰色鈣質頁岩及薄层石灰岩，底部为黑色燧石层。上部产 <i>Agnostus</i> , <i>Raptagnostus</i> , <i>Megalaspis</i> <i>Hedinia</i> 等 455米
中寒武系	莫呼尔山統( $Cm_2^M$ ) 浅灰色薄层石灰岩夾少量中厚层石灰岩。产 <i>Dorypyge</i> , <i>Fuchouia</i> , <i>Hypagnostus</i> , <i>Goniagnostus</i> , <i>Ptychagnostus</i> 等。 165.5米		
下寒武系	西大山統 ( $Cm_1^S$ ) 黑色燧石层及浅灰色薄层石灰岩与鈣質頁岩互层。产 <i>Redlichia</i> , <i>Palaeolenus</i> , <i>Obalus</i> 125.4米	黑色燧石层 30米	

黑色頁岩,上部为深灰色厚层石灰岩及綠色頁岩。厚約 250 米。在中部頁岩中产笔石:*Didymograptus* cf. *superstes* Lapworth, *Climacograptus scharenbergi* Lapworth, *C.* cf. *uniformis* Hsü, *Glyptograptus teretiusculus* (Hisinger) var. cf. *englyphus* (Lapworth), *Cryptograptus tricornis* (Carruthers), *Amplexograptus* sp.。諾林的上奥陶紀土什克布拉克系出露在罗布泊西北約 100 里的土什克布拉克地区。下部为棕色凝灰質、砂質板岩、长石質石英岩及綠色板岩;上部为厚层玢岩伴有块状坚硬长英角岩質岩石,主要是綠色、黄色、紅色或紅棕色緻密玢岩質和角斑岩質的凝灰岩及火山灰。

近年来新疆地質局在硫磺山进行了較詳細的矿区地質勘探工作,发现有奥陶紀地层,底部为綠色砂岩,千枚岩及含有火山岩砾石的砂砾岩,中部逐渐变为綠色硬砂岩夹少量薄层石灰岩,其中还夹有綠色的安山岩透鏡体,上部出現紫紅色石灰岩,泥質頁岩,其中含大量的海百合莖,头足类及珊瑚等化石,此次我們赴該区进行了观察并采集了一些化石,計有 *Troedssonoceras* sp., *Michelinoceras* sp., *Corbyoceras* sp., *Discoceras* sp., *Sinoceras rudum* Yü 以及珊瑚 *Protozaphrentis minor* Yü 等化石。再上为綠色絹云母石英片岩,綠色花崗片麻岩、中夹有浅紅色长石砂岩,綠色硬砂岩以及角砾状石灰岩。共計厚度約 1500 米。按其所含头足类化石来看,这些种属都是中奥陶系下部常見的种属,因此中奥陶紀地层的存在是毫无疑问的,但在下伏一大套經受变質的岩层中夹少量石灰岩透鏡体,其中产有 *Atrypa desquamata* Sowerby, 看来应属中泥盆系上統。

在莫呼尔山整复于上寒武紀地层之上的一套灰白色块状白云岩及白云岩与石灰岩互层,可能属于下奥陶系底部岩层,因未找到完整的化石,还待进一步研究肯定。

## 2. 柯坪塔克区的寒武、奥陶系

### 寒武系:

柯坪塔克附近的寒武紀地层出露不全,在其南坡下部主要是一套杂色砂岩、頁岩及泥岩并含盐及石膏,厚約 300 米。中上部以深灰色白云岩及石灰岩的互层为主,夹少量含磷灰岩、砂質岩及泥灰岩,本层在苏巴什以北 5 公里之拜西卡尔塔克沟口出露較广。厚約 700 米,本层与上述之杂色岩系的接触关系不明。1957 年地質部 13 大队第 9 中队在柯坪以北苏盖特布拉克附近找到了寒武紀地层的完整剖面,且出露广泛,其下部以交角不整合分別复于元古代片岩及震旦紀砂頁岩之上。根据該队所測地层剖面由上而下簡述如下:

上复地层——薩尔干岩系 ( $O_2$ )<sup>18</sup> (中奥陶系)

——整合接触——

丘里塔克岩系 ( $Cm-O_1$ )<sup>14</sup>

(5) 灰色白云岩及灰岩,含有燧石透鏡体和結核,在上部石灰岩中产头足类化石:

*Protocycloceras* sp., *Cyrtoceras* sp. 等。

1000—2000 米

阿瓦塔克岩系 ( $Cm$ )<sup>17</sup>

(4) 絳紅色泥岩,粉砂岩帶有泥灰岩,白云岩及石膏夹层,頂部为泥灰岩和白云岩互层。

130—250 米

(3) 薄层白云岩,块状灰岩夹黄色泥灰岩并有石膏层,底部薄层白云岩中产三叶虫化石。

220—240 米

(2) 灰色及深灰色不同厚度的白云岩,其中夹有黑色灰岩,砂質层和炭質頁岩的



夹层,灰岩中产三叶虫化石。

280—340 米

- (1) 下部为綠紅色砂岩頁岩,上部为灰白色石英質砂岩及頁岩,底部有一层厚度不稳定的砾岩。

400—920 米

~~~~~交角不整合~~~~~

下伏地层——元古代及震旦紀 (Pt—Sn) 片岩及砂頁岩。

上述剖面中所产三叶虫化石,据卢衍豪先生鑑定,认为第三层中是一个新属,其时代应为下寒武紀的中、上期。在第二层中所产的三叶虫是 *Redlichia* 科的一新属,其时代应为下寒武紀的早期,相当于滄浪鋪統底部,看来至少不会高于庫魯克塔克区 *Palaeolenus* 的层位。

奥陶系:

柯坪塔克地区的奥陶紀地层,前人做过很多工作,其中尤以西尼村和地質部 13 大队的工作有重大参考价值。我們这次所测奥陶紀地层剖面的地点是在柯坪县西北約 20 里的苏巴什沟口,該区地层出露較好,构造簡單,剖面完整,且化石丰富,保存較好。茲将所测剖面自上而下叙述如下:

上复地层——柯坪塔克統(志留紀)

----平行不整合----

薩尔干統( $O_2^1$ )

- (14) 灰綠色砂質頁岩夹褐灰色砂質灰岩条帶,本层中未采得化石。 50 米

- (13) 灰綠色砂質灰岩,未采得化石。 15 米

- (12) 浅灰綠色砂質灰岩夹少量土紅色泥灰岩。 20 米

- (11) 灰綠色鈣質頁岩夹綠灰色泥灰岩条帶,在泥灰岩条帶中采得笔石共 4 层,自上而下为: 1) *Amplexograptus* cf. *maxwelli* Decker (SKK 224); 2) 再向下 15 米处为 *Pseudoclimacograptus scharenbergi* var., *Orthograptus* cf. *apiculatus* Elles et Wood, *Amplexograptus* cf. *maxwelli* Decker (SKK 223); 3) 再向下約 25 米处为 *Amplexograptus* cf. *maxwelli* Decker (SKK 222); 再向下 20 米处为 *Amplexograptus* cf. *maxwelli* Decker, *Dicranograptus* sp., *Orthograptus apiculatus* (SKK 221) 55 米

- (10) 浅灰綠色鈣質頁岩,风化后呈紙片状,表面呈褐灰色,本层中未采得化石。 25 米

- (9) 褐灰色泥灰岩及綠灰色团块状石灰岩互层,在本层上部采得头足类: *Orthoceras suni* Yü, *Sinoceras rudum* Yü, *Sinoceras chinense* (Foord), *Michelinoceras* spp., *Palaeocycloceras wangi* Yü, *Sinoceras chinense* (Foord), *Orthoceras squamatulum* Barrande, *Biscoceras* sp., *Lituities* ? sp., 三叶虫 *Basiliella* sp.; 腹足类 *Bucanella* sp. (SKK 220) 30 米

- (8) 土紅色薄层泥質团块状石灰岩,在頂部采得头足类: *Orthoceras regulare* Schlottheim, *Michelinoceras* sp. nov., *Orthoceras* cf. *squamatum* (Barrande), *Fabroceras* sp., *Sinoceras rudum* Yü, *Pseudorthoceras* sp., *Lituities* sp., *Polygrammoceras* sp., *Discoceras* sp. nov., 三叶虫 *Basiliella* sp. (SKK 219) 15 米

- (7) 炭質頁岩层,风化表面呈灰綠色,13 大队曾在本层中找到了笔石: *Climacograptus diplacanthus* Bulman.

丘里塔克統( $O_1^1$ )

- (6) 灰綠色和土紅色薄层瘤状石灰岩,富含头足类化石及少量三叶虫化石。头足类: *Endoceras lui* Yü, *Richardsonoceras* sp., *Vaginoceras* spp., *Armenoceras* sp., *Sactoceras*

- sp., *Cyrtendoceras* *Ormoceras* sp., *Cyrtoceras* sp.; 三叶虫: *Ptychopyge* sp., *Asaphus* sp., *Isotetoides* *Iliaenus* sp., *Nileus* aff. *armadillo* Dalman; 腹足类: *Ophileta* sp., *Bucania* sp. (SKK 218) 8 米
- (5) 褐灰色厚层石灰岩夹薄层瘤状石灰岩, 中部采得头足类: *Polygrammoceras lineatum* (His.), *Polygrammoceras* spp., *Pseudorthoceras* sp., *Michelinoceras* sp., *Vaginoceras* sp., 三叶虫 *Nileus* aff. *armadillo* Dalman, *Ptychopyge* sp. (SKK 217) 7.5 米
- (4) 灰绿色薄层石灰岩夹少量瘤状石灰岩, 产头足类化石 *Plectronoceras* sp., *Camero-ceras* sp. (SKK 216a) 9 米
- (3) 褐灰色块状石灰岩, 含少量燧石结核, 顶部受铁质浸染, 中部采得腹足类: *Ecculiom-phalus* sp., *Maclurites* sp. (SKK 216b) 35 米
- (2) 褐灰色砂质灰岩夹少量泥质灰岩。 50 米
- (1) 暗灰色厚层石灰岩夹少量白云岩, 底部出露 15—20 米厚之白云岩。 135 米
- 整合接触——

下伏地层——阿瓦塔克岩系(寒武系)

根据上述剖面概说如下:

中奥陶系——萨尔夫干统( $O_2$ ) 217 米

下奥陶系——丘里塔克统( $O_1$ ) 244.5 米

上述奥陶系剖面中的地层单位, 中奥陶系仍采用 13 大队所命名的萨尔夫干岩系, 但所包括的范围除炭质页岩、团块状石灰岩外, 还包括团块状石灰岩上部的钙质页岩, 泥灰岩夹石灰岩条带的一套岩层, 比较原萨尔夫干剖面出露为厚。西尼村将奥陶系上部命名为苏巴什岩系(Субашийская свита), 但此名称曾被诺林命名为东库鲁克塔克的二迭纪地层, 为了避免混淆, 应予废除。下奥陶系係采用西尼村和 13 大队命名的丘里塔克岩系, 但我们适用的范围只限于从炭质页岩下部的灰绿色和土红色厚层瘤状石灰岩向下到出露有 15—20 米厚的白云岩为止共 244.5 米。

由上列剖面, 我们可以看到萨尔夫干统中从下到上含化石非常丰富, 因石灰岩泥质成分较多, 化石极易从岩石中风化脱落而出, 且保存完美。根据现有的这些材料并参照了 13 大队的柯坪山区、普昌山区及卡拉泰克山区的下部古生代地层剖面及其所产化石, 我们认为萨尔夫干岩系本身所产各层化石, 彼此差别很大, 分布较广, 各有其固定的层位。这对层位的对比上具备了有利条件。如第 8 层中所产的 *Sinoceras rudum* Yü 数量很多且保存完整, 这个种曾被杨敬之、穆恩之作为鄂西艾家山统的分带化石; 根据野外观察及室内的研究, 无论从化石本身或岩石性质上看, 均可与鄂西艾家山统的 *Sinoceras rudum* 带相比较, 应为中奥陶系下部。在上列剖面的第 6 层中所产的头足类化石, 其特点个体数量较多, 与杨、穆艾家山统剖面中的 *Yangtzeella poloi* 带下部 BY18 层所产化石大同小异, 过去一直被认为是中奥陶系下部的动物群, 可是 1957 年本所王钰、穆恩之、李积金、蒋福新、葛梅钰等在鄂西 *Yangtzeella poloi* 带中采得许多下奥陶纪的笔石, 显然这一化石带应属于下奥陶纪。在我们的剖面中无论从岩性上或者从头足类和三叶虫动物群来看, 第 6 层中所产化石与其上之第 8 层中所产化石的种属有显著不同, 大部分种属在欧洲或其他地区都是下奥陶纪常见的种属, 因此将第 6 层及其以下列入下奥陶系是合适的, 其层位相当于兰维林统(Llanvirlian)或加拿大统(Canadian)的上部。另外值得提出的是在第 6 层中发

東 45 爾



現了北方馬家沟統中常見的 *Sactoceras* spp., *Ormoceras* sp., *Armenoceras* sp. 等,这是很有趣的,这不但对解决南北类型头足类动物羣的亲緣关系以及在古地理上具有意义外,而且也有利于南北奥陶紀地层的对比,这自然也涉及到馬家沟統的时代問題。在第11层中所产的 *Amplexograptus* cf. *maxwelli* Decker 等笔石都产于泥灰岩条带中,保存較好,这些种、属都是我国各地中奥陶系中上部常見的种、属。

从所采得的头足类种、属来看,这个动物羣与揚子三峡区的艾家山統中的头足类非常相近,而一部分种、属与波罗的海直角石灰岩中所产种、属相同,另一些种、属,則为北方馬家沟統中常見的种、属,这种現象不但可以說明头足类南北两大类型的动物羣不是彼此隔絕而是互相沟通的,可能祁連山、賀兰山与內蒙桌子山的奥陶紀海侵还是有缺口而与天山相連。另一方面从生物本身亦反映出当时海水深度和气候条件亦在相繼递变,如剖面中第4第5两层中所产头足类化石是具有厚的外壳、大的气室,适于海底动盪較大、含泥砂量較多的浅海环境中生活的种、属,而向上到第6层中开始出现具有薄的外壳和小的气室并适应于較深水区底棲生活的种、属,这一层从岩性上来看由土紅色泥质瘤状石灰

#### 柯坪塔克区的奥陶紀地层

| 紀    | 张日东、俞昌民、陸麟黃、張遵信 (1958)                                                                                                                                                                                                                 | 西 尼 村 (1957)                                                                                                                |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 中奥陶紀 | 薩尔干統( $O_2^1$ )<br>底部为黑色頁岩,中上部为灰綠色及土紅色团块状石灰岩,向上变为綠色鈣质頁岩夾泥灰岩条带。产: <i>Climacograptus diplacanthus</i> Bulman, <i>Basiliella</i> , <i>Sinoceras rudum</i> Yü, <i>Pseudoclimacograptus</i> , <i>Amplexograptus</i> 等<br>217 米              | 苏巴什統<br>泥质灰岩及泥灰质頁岩。产: <i>Orthoceras</i> , <i>Asaphus</i> , <i>Ogygia</i> , <i>Sphaeronis</i><br>130 米                       |
| 下奥陶紀 | 丘里塔克統( $O_1$ )<br>底部为灰白色白云岩,其上为深灰色中厚层石灰岩,上部为灰綠色夾土紅色瘤状石灰岩。产: <i>Endoceras</i> , <i>Ormoceras</i> , <i>Cyrtoceras</i> , <i>Camero-ceras</i> , <i>Ptychopyge</i> , <i>Asaphus</i> , <i>Iliaenus</i> , <i>Ecculioniphalus</i> 等<br>244.5 米 | 丘里塔克岩系<br>浅灰色石灰岩及灰质砾岩和砂岩。产: <i>Estonisceras</i> , <i>Endoceras</i> , <i>Ischadites</i> , <i>Maclurites crassus</i><br>600 米 |

#### 庫魯克塔克区及柯坪塔克区寒武、奥陶紀地层对比

| 紀    | 庫 魯 克 塔 克 区         | 厚 度 (米) | 柯 坪 塔 克 区        | 厚 度 (米)              |
|------|---------------------|---------|------------------|----------------------|
| 上奥陶紀 | 土什克布拉克系( $O_4$ )    |         |                  |                      |
| 中奥陶紀 | 上却尔恰克系( $O_{3-2}$ ) | 250     | 薩尔干統( $O_2^1$ )  | 217                  |
| 下奥陶紀 | 下却尔恰克系( $O_1$ )     | 10      | 丘里塔克統( $O_1^1$ ) | 244.5                |
| 上寒武紀 | 特爾沙克塔克統( $Cm_3^1$ ) | 215.8   | 阿瓦塔克岩系           | $Cm_{av3-4}$<br>>350 |
| 中寒武紀 | 莫呼尔山統( $Cm_2^m$ )   | 165.5   |                  |                      |
| 下寒武紀 | 西大山統( $Cm_1^s$ )    | 125.4   |                  | $Cm_{av1-2}$<br>>680 |

註 本表中庫魯克塔克区的奥陶系是根据諾林資料;柯坪塔克区的寒武系是根据地質部13大队資料。

岩逐渐变为灰绿色瘤状石灰岩,这是海水由浅变深,由氧化环境向还原环境变化,这种生存环境的显著改变,使生物遭到大量死亡,因而在第6层中形成了丰富的化石层,沉积物亦因还原作用而形成上复的黑色页岩层。黑色页岩之上开始出现土红色泥质团块状石灰岩,这种环境又使头足类获得了生存和繁殖的机会,但个体小,种、属少与黑色页岩之下的种、属有显著的不同。

根据13大队普查资料,新疆天山南部奥陶纪地层出露较广,在柯坪山坡萨尔干岩系出露较厚,底部具有3—5米厚的黑色页岩,向上为土红色泥质团块状石灰岩,向上石灰岩增多,其岩性大致与苏巴什沟口的萨尔干岩系相同,厚度约230米。丘里塔克岩系的岩性与苏巴什沟口完全一致,唯厚度有增加约300米。普昌山区萨尔干岩系的厚度有显著减小,约80米,而下伏之丘里塔克岩系的岩性稍有变化,大部为暗灰色结晶灰岩并夹有燧石结核,厚约500米。卡拉泰克山南坡,萨尔干岩系厚度显著变薄约65米,而丘里塔克系完全是灰色层状砂化石灰岩,厚度约360米。在苏盖特布拉克一带萨尔干岩系出露较厚,约250米,岩性与苏巴什沟口极其相似;在本岩系下部产头足类 *Discoceras eurasiaticum* Frech, *Sinoceras* sp., 笔石 *Climacograptus* sp., 三叶虫 *Ogygites* sp. 等, 丘里塔克岩系的厚度约400米。但在乌什南东一带,萨尔干岩系的沉积全部被剥蚀,柯坪塔克岩系直接复于丘里塔克岩系之上。由此可见萨尔干岩系以柯坪为中心有从东南向西北逐渐变薄的趋势。同时也说明本岩系沉积之后曾有一较长的侵蚀阶段存在。

## (二) 志留、泥盆纪地层部分

### 1. 库鲁克塔克区的志留泥盆系

库鲁克塔克区志留泥盆纪地层的分布情形据调查所及和目前已有的资料看来,在辛格尔约(北纬 $41^{\circ}30'$ )以北地区有着广泛出露,主要分布在克兹尔塔克及其以北地区,大致呈北西—南东走向,绵延不绝。这个时期的沉积物在本区大部分是接近于地槽型的沉积,构造断裂发育,再加受后期火成岩侵入作用的影响,地层普遍遭受变质,很难找到完整的剖面。

瑞典人诺林1927—1934年在本区调查时,曾将这个时期的地层笼统地命名为阿尔皮斯米布拉克系及干沙河系,诺林的标准剖面在阿尔皮斯米布拉克之东,其岩序和主要动物群如下:

(6) 灰蓝色块状珊瑚礁灰岩夹钙质页岩,部分有石英脉和方解石脉穿插,厚数百米。含化石: *Favosites gotlandicus* Lamarck var. *aberrans*, *F. interstinctus* Regnell, *Thamnopora incerta* Regnell, *Stratipora* sp., *Alveolites laminatus* Regnell, *Aulopora* sp., *Heliolites interstinctus intermedius* Wentzel, *Dokophyllum* (?) sp., *Teratophyllum* (?) sp., indet.

(5) 红棕色泥质及钙质页岩,顶部有浅灰色致密块状灰岩(厚2米),厚约50米。含化石: *Favosites gotlandicus* Lamarck var. *spinosa* Regnell, *F. yernolaevi* B. B. Chernishev, *Teratophyllum hedinii* Regnell, *Cystiphyllum cylindricum* Lonsdale var. *lasiceptis* Regnell, *Angopora jonesi* Regnell, *Plasmopora aseptata* Regnell, *Amplexus* (?) sp., *Atrypa reticularis* Linn.

(4) 深蓝灰色块状灰岩,厚约70米。

(3) 绿色页岩夹浅蓝色薄层灰岩层,石灰岩层面风化后呈黄色,厚约100米。含化石: *Favosites weis-*

*sermeli* Regnell, *Spirifer*, *Camorphoria Levenea* (?), *Nucleospira*, *Leperditia* 及节頸类魚化石碎片等。

(2) 淡灰色石灰岩为主,部分为細致燧石石灰岩,夹紅色薄层頁岩和石灰岩层(厚几厘米到1米),厚50—100米,灰岩中产化石 *Omphyma* (?) sp., *Amplexus* (?) sp., *Wilsonia*, *Leptaena*, *Pterinea*, *Modiomorpha* (?) spp., *Goniophora*, *Platystoma*, *Subulites*, *Bellerophon* 等

(1) 綠灰色泥质板岩和細致石英質砂岩,厚度不詳。

根据化石性質,諾林等认为第(1—5)层属上志留紀,第(6)层可能属下泥盆紀。由于沒有明确的界綫,諾林籠統地以阿尔皮斯米布拉克系一名概括这段地层,时代定为志留泥盆紀。

阿尔皮斯米布拉克系这一地层名詞及其时代含义沿用到現在,一直沒有变更。

我們在工作期間先后曾在干草湖及其以西地区,阿拉塔克以及阿尔皮斯米布拉克北东4里附近等地区測制了若干剖面,并且分层采集了許多化石,現將我們的分层意見簡述如下:

#### 中志留系——硫磺山統

主要出露在阿拉塔克区,其东坡有硫磺矿,所以地質部的同志又称硫磺山。这里,岩层的橫向变化十分剧烈,构造断裂比較复杂而且普遍遭受变质,加之采获的化石未能詳細进行室內鑑定,所以地层时代还不能确切地肯定。

上复地层——上志留系

——連續关系——

上部:灰岩-砾岩层,砾石成分全为大理岩化的灰岩,扁圓状,砾径数厘米至数毫米不等。按一定方向排列(大致呈东西向),胶結物为浅褐色粉砂质。厚70米。

下部:紫褐色及綠色砂岩至粉砂岩,砂岩中夹含灰岩凸鏡体,其中含珊瑚化石 *Cystiphyllum* cf. *cylindrica* Lonsdale, *Favosites* sp., *Heliolites* sp., *Plasmopora* sp. 等是志留紀特别是中志留紀較为常見的种、属。砂岩层底部尚夹有綠色千枚岩层。厚約400米。

——断层接触——

下伏地层——中奥陶紀結晶灰岩层

上述地层的时代根据珊瑚化石暫定为中志留紀,我們以硫磺山統命名之。

上志留系——阿拉塔克統

分布在阿拉塔克区。上部与下泥盆紀地层为断层接触,下部与中志留系为連續沉积,局部地区为断层接触。我們和13大队罗发祚同志在阿拉塔克以西,相当20万分之一地形图上标高1782公尺山头的南70°东处測制了一个剖面,初步結果簡述如下:

上复地层——下泥盆系黑色薄层灰岩

——断层接触——

(11) 綠色粉砂岩夹薄层灰岩,灰岩呈凸鏡体,中含大量牀板珊瑚化石 *Favosites* sp. 但均遭变质。

30米

(10) 綠色石英綠泥石片岩中夹白色大理岩凸鏡体。大理岩凸鏡体时厚时薄,最厚可达10—20米,沿走向断續出露。

113.75米

(9) 浅綠色至綠色粉砂岩中夹白色大理岩凸鏡体。

87.8米

(8) 紫色細砂岩。

24米

(7) 浅綠色千枚岩。

34.6米

(6) 白色薄层状大理岩。

18.1米

- (5) 灰色—灰綠色粉砂岩夹凸鏡状薄层灰岩。 59.6 米
- (4) 黑色薄层灰岩夹少量紫色細砂岩全粉砂岩, 灰岩中采得少数林板珊瑚。 110.9 米
- (3) 黑色薄层状灰岩富含林板珊瑚及少量单体珊瑚。 99 米
- Kyphophyllum?* sp., *Cystiphyllum* sp., cf. *Micula* sp., *Squmeofavosites* sp., *Heliolites* sp., *Favosites* sp., *Thamnopora* sp.
- (2) 灰色薄层状灰岩与黃褐色薄层状泥灰岩的互层。 43.2 米
- (1) 灰白色致密块状灰岩, 底部被火成岩侵入, 岩层均砂卡岩化, 且被第四紀砾石层掩盖, 底部未完全出露。 41.2 米

从上述岩层中的化石性質看来, 許多属都具有志留紀的性質。其中 *Squmeofavosites* 一属是上志留紀至下泥盆紀地层中的重要化石, 天山南部相当地层中已經出現; *Kyphophyllum*, *Micula* 等属产在烏拉尔西坡上志留紀地层中, 为苏联西套娃(Sytova)所描述, 从化石性質来說, 我們认为上述这一套地层可暫归入上志留紀, 以其出露地区阿拉塔克命名之。

諾林曾穿越这个地区把上述中、上志留紀地层都归入他創立的“喀拉其吉尔杂岩系”內, 时代定为寒武奥陶紀, 沒有化石依据; 地質部的同志則把它們都归入中下志留系, 仅在我們划作中志留紀的地层內采到类似的珊瑚化石。

#### 下泥盆系——阿尔皮斯米布拉克統:

主要出露在阿尔皮斯米布拉克附近, 此外在阿拉塔克区仅底部露出。現將二区出露的地层分別叙述如下:

阿尔皮斯米布拉克区: 作者之一(俞昌民)偕同地質部第 13 大队馬宝山同志曾在阿尔皮斯米布拉克北东 4 里处測制了一个剖面, 并分层采集了一些化石。从地形上看来我們所測的剖面位置約在諾林測制的剖面以北, 相距約有 6 里, 与諾林剖面中的第十一号化石地点可能相距較近。这里的地层褶曲相当剧烈, 岩层产状比較紊乱, 总的傾向約在南  $30^{\circ}$ — $40^{\circ}$  西之間, 傾角自  $30^{\circ}$ — $70^{\circ}$  不等, 其中含化石非常丰富, 主要是珊瑚及腕足类等, 其岩序及所含化石經初步鑑定如下:

#### 上复岩层——第四紀戈壁砾石层。

- (10) 綠褐色及黃褐色粉砂岩或砂質泥岩夹泥灰岩凸鏡体, 灰岩中产珊瑚 *Pseudomicroplasma* sp., *Sinkiangophyllum sinkiangense* Yü (新属新种), *Rhizophyllum* sp., 等及腕足类 *Grünwaldtia* sp. 5 米
- (9) 浅灰色厚层灰岩中夹黃褐色泥岩或粉砂岩 6 米
- (8) 浅灰色中厚层状灰岩, 富含大型单体珊瑚 *Tryplasma* (*Pholidophyllum*) cf. *maximum* Chernyshev, *Tryplasma* sp. 31 米
- (7) 浅灰近白色块状灰岩, 質致密坚硬, 似含白云質, 95.76 米
- (6) 草綠色砂質泥岩, 頂部黃褐色頁岩中夹薄层灰岩凸鏡体, 含腕足类 *Grünwaldtia* sp. 及珊瑚化石。 60 米
- (5) 浅灰色风化后呈深灰色, 局部为黃褐色薄层灰岩夹黃綠色鈣質—砂質泥岩, 頂底部灰岩中富含珊瑚及腕足类化石。 29 米

珊瑚类: *Tryplasma* sp., *Sinkiangophyllum* sp., *Leptinophyllum* sp., *Thamnopora* sp., *Favosites* sp.

腕足类: *Camarotoechia* sp., *Uncinulus* sp., *Grünwaldtia* sp.

- (4) 淡黃褐色至浅灰色(上部)薄层泥質灰岩夹深灰色厚层灰岩, 中部产腕足类: ?*Grünwaldtia* sp. 13.2 米
- (3) 浅灰色风化后呈深灰色薄层灰岩(单层厚約 4 厘米)与黃綠色頁片状粉砂岩至砂質泥岩的互

层,底部灰岩中富含珊瑚及腕足类。

40.4 米

珊瑚类: *Pseudomicroplasma* sp., *Leptoinophyllum* sp., *Squmeofavosites* sp., *Thamnopora* sp., *Favosites* sp.

腕足类: *Uncinulus* sp., *Grunewaldtia* sp., *Leptaena* sp., *Schuchertella* sp.等。

(2) 浅灰色风化后呈深灰色之块状(近本层下部)及薄层灰岩。底部灰岩中采获少量腕足类及珊瑚化石,因保存不佳,无法鑑定。

22.8 米

(1) 浅白灰色块状灰岩,质坚密,风化后局部被铁质浸染成红色,底未露出。本层组成背斜层,在其东北翼采得少量腕足类化石 *Grunewaldtia* sp.

40 米

上列剖面中的腕足类化石系本所王钰同志鑑定的。根据他的意见:剖面内的腕足类化石自下而上性质几乎没有什么变化,其中除 *Grunewaldtia* 一属系德国莱茵区中泥盆系下部爱菲尔统中的重要化石以外,其余各属在泥盆纪上下地层中,甚至在志留纪地层中均可出现。

从珊瑚化石来看许多属和瑞格南尔(Regnell)描述的相似,尤其是诺林剖面中第十一号化石地点的一些种属。不过瑞格南尔的许多种属名称现在看来是需要重行订正的。*Tryplasma*(可能和 Regnell 描述的 *Amplexus*? sp. 相同),以及 *Rhizophyllum* (Regnell 误订为 *Teratophyllum*) 等属在志留系分布相当广泛,一直可延续到下、中泥盆系;*Pseudomicroplasma* 在下泥盆纪和中泥盆纪地层中均有发现,在南天山西部下泥盆纪地层中也有发现;*Leptoinophyllum* 在北欧及乌拉尔等地均产于中泥盆纪和下泥盆纪地层中;新属 *Sinkiangophyllum* 和志留纪的 *Kyphophyllum* 以及泥盆纪的 *Tabulophyllum* (即单体型的 *Endophyllum*) 都很相似,可能代表它们中间的过渡型;林板珊瑚类中的 *Squmeofavosites* 是上志留系及下泥盆系中的重要化石,在南天山西部相当地层中也很丰富;上述这些化石群除天山以外在我国其他地区尚未发现,所以很难和我国已知的任何地点的化石群进行对比,但是和南天山西段(喀什以北),苏联乌拉尔区甚至北欧某些地区的下泥盆系中的珊瑚群却很相似,并且和一部分中泥盆系下部的珊瑚群也较接近。

综上所述,我们认为上列剖面中的地层归于泥盆系,代表下泥盆纪的沉积的可能性是比较大的。虽然其中也带有一些志留纪尤其是上志留纪的成分,但是泥盆纪的成分还是占优势。

诺林创立的阿尔皮斯米布拉克系的标准地点在我们的剖面的附近,其中采获的珊瑚化石经瑞典瑞格南尔鉴定后发表在中瑞考查报告第 17 号(Regnell, 1941)。从珊瑚化石的性质看来和我们采集的一些种类都比较接近,尤其是第 11 号化石地点的一些种类。诺林等结合野外观察也认为这段地层的时代属于下泥盆纪。至于诺林认为属于上志留纪的第(1—6)层,从化石性质上对比与第 11 号化石地点的一些种、属性区别不大,虽然其间确实带有一些志留纪的成分,而和我们剖面中的地层无论从岩性和化石性质方面都比较接近。因此我们认为诺林的阿尔皮斯米布拉克系的时代属于下泥盆纪是比较合适的。我们建议仍然保留阿尔皮斯米布拉克系这一地层名词来代表本区下泥盆纪地层。

阿拉塔克区:在这里出露的下泥盆纪地层看来应属于下泥盆系下部的地层。其中的白色块状灰岩层在本区组成高峻的陡崖,即阿拉塔克的主体。作者之一(俞昌民)和地质部 13 大队罗发祚同志在阿拉塔克西南山脚下测制了一段剖面,自上而下简述如下:



(3) 白色块状石灰岩, 頂未露出, 地形上突出成陸崖。

約 130 米

(2) 褐色鈣質砂岩至粉砂岩中夾紫色砂岩透鏡體。

30.4 米

(斷層角礫岩及綠泥石片岩組成之碎屑岩帶)

—·—斷層接觸? —·—

(1) 綠色綠泥石英變質砂岩至粉砂岩, 沿裂隙有次生褐鐵礦脈及次生石英脈。底部為第四紀礫石層掩復, 未露全。

約 50 米

从这个剖面向东 200 米左右, 在白色灰岩层之下出现数层黑色薄层灰岩, 灰岩向两侧延伸逐渐变薄, 在很短距离内即消失, 很可能是呈凸镜体状夹含于砂岩内。在薄层灰岩中采获了少数珊瑚化石, 虽然变质较深, 但勉强尚可鉴定, 计有: *Pachyfavosites* sp., *Thamnopora* sp., *?Breviphyllum* sp. 等属, 已具有泥盆纪的色彩。再者, 从块状灰岩的岩性看来和阿尔皮斯米布拉克剖面中底部的白色块状灰岩岩性几乎完全一致, 而且在地理分布上两者大致是在同一走向线上, 结合以上几点我们认为白色块状灰岩及其下的数层碎屑岩层有可能属于下泥盆系下部的地层, 顶部的灰岩层似乎可以和阿尔皮斯米布拉克剖面中底部的白色灰岩相衔接。

以上白色块状灰岩的时代, 诺林把它当作喀拉其尔杂岩系的一部分, 定为志留纪或寒武奥陶纪。地质部的同志则把它当作上志留纪。他们对上述岩层时代的推断主要依据岩性观察, 没有化石证据。

#### 中泥盆系下部——卡拉塔克组

分布在阿拉塔克东南部, 在硫磺山矿区范围内, 顶、底分别和奥陶系及侏罗系呈断层接触。

上部: 绿色凝灰砂岩层为主, 夹少数凝灰砾岩层, 砂岩层中夹含黑色及褐灰色灰岩的透镜体, 地质局地层队的同志在其中采获大量腕足类化石, 经鉴定为 *Atrypa desquamata* Sowerby。

#### 下部: 绿色凝灰砾岩层

出露总厚度约 500 米。

诺林的喀拉其尔杂岩系包括了上述凝灰砂砾岩系, 时代误定为寒武奥陶纪。地质局的同志在本区工作期间将上述地层的时代定为中奥陶纪早期。从上述地层的岩性看来应属火山喷发岩系, 由于在其中的灰岩凸镜体中找到了腕足类化石 *Atrypa desquamata*, 我们可以确定其时代为中泥盆纪。但是和中泥盆系上部及下泥盆系相比, 均无如此厚度的喷发岩系存在, 因此我们暂时把它当作中泥盆纪下部 (Eifelian) 的地层。

#### 中泥盆系上部——派尔萨布拉克组

这个时期的地层有可靠的化石证据的在本区仅发现一处, 即干草湖以西 80 里左右, 派尔萨布拉克南西 24 里左右的 1539 高地。这里, 中泥盆纪上部地层出露厚度约 200—250 米, 上下均与侏罗纪地层呈断层接触, 局部地层且为后期花岗岩体侵入, 地层褶皱比较剧烈, 普遍遭受变质, 倾向约北 42° 东, 倾角 40—60° 不等, 其岩序及化石初步鉴定结果如下:

上复地层——侏罗系

—·—断层接触—·—

(5) 黑色厚层灰岩, 近顶部处采得珊瑚 *Thamnopora* sp., *Stratipora* sp. 及单体四射珊瑚等。约 135 米

(4) 浅灰色风化后呈褐色之砾状灰岩层,砾石成份为单一的石灰岩砾,半圆状及半稜角状均有。

15 米

(3) 棕黑色厚层灰岩中夹薄层泥质灰岩一层(50厘米厚),含珊瑚化石。

*Wedekindophyllum* cf. *corneolum* Wdkd., *Wedekindophyllum* sp., *Favosites* sp., *Thamnopora* sp., *Stratipora* sp. 及苔藓虫化石。

5 米

(2) 浅灰色风化后呈玉红色薄层灰岩夹少数页岩层,含珊瑚化石。

*Wedekindophyllum* sp., *Grypophyllum* sp., *Temeniophyllum Waltheri* Yoh, *Favosites* sp., *Thamnopora* sp. 等及腕足类化石。 *Atrypa* sp., ?*Conchidium* sp. 等底部灰岩中并杂有石灰岩小砾。

5 米

(1) 棕灰至深灰色厚层灰岩。含海百合茎。

90 米

——断层接触——

下伏地层——侏罗系

从珊瑚化石的性质来看,上述地层的时代无疑应属中泥盆纪晚期(即 Geritian 期)。其中的许多化石无论在南山西部,中国西南陆台的中泥盆纪晚期地层中以及乌拉尔区,欧洲莱茵河区的相当地层中均有发现。

此外,在克兹尔塔克区的通古兹布拉克附近出露一套厚约 200 米左右的薄层灰岩夹砂岩及片岩层,灰岩中采获少量珊瑚化石有 *Pachyfavosites*? sp., *Thamnopora* sp. 等,其上连续沉积着上泥盆纪地层。上述地层亦可入中泥盆系上部 and 1539 公尺高地出露的地层相当。本区中泥盆系上部的地层我们命名为派尔萨布拉克组。

上泥盆系下部——砂石山组

我们在派尔萨布拉克西北18里左右的砂石山区测制了一个比较整齐的剖面(见图5),可惜上下地层均与侏罗纪地层分别呈不整合与断层接触。上泥盆纪地层的主要岩性以深灰色薄层泥质灰岩为主夹黄绿色薄层砂岩及页岩。灰岩中采获丰富的腕足类、苔藓虫及头足类化石,现将剖面内的岩序及化石的初步鉴定结果简述如下:

上复地层——侏罗系

~~~~~不整合~~~~~

- |   |        |
|---|--------|
| (13) 薄层黑色灰岩,含腕足类 (SKP 019) <i>Cyrtospirifer</i> sp.   | 78.8 米 |
| (12) 中厚层淡灰色灰岩   | 28.8 米 |
| (11) 薄层泥质灰岩   | 5 米    |
| (10) 黄色钙质粗粒砂岩   | 5 米    |
| (9) 页岩夹灰岩结核体  | 5 米    |
| (8) 中厚层淡灰色灰岩  | 13.6 米 |
| (7) 薄层黑色灰岩夹页岩,含腕足类 (SKP 018) <i>Schuchertella</i> sp., <i>Yunnanella</i> sp., <i>Athyris</i> sp., <i>Cyrtospirifer</i> sp. 等。 | 10.2 米 |

(6) 黄绿色页岩含腕足类 (SKP 017, 016) *Yunnanella* sp. 等及苔藓虫、头足类化石。 7 米

(5) 黄绿色及棕色页岩及砂质页岩与薄层黑色泥质灰岩互层,薄层灰岩中富含腕足类 (SKP 006—015) *Cyrtospirifer* (= *Sinospirifer*) sp., *Yunnanella* sp., *Yunnanellina* sp., *Schuchertella* sp., *Camarotoechia* sp. 等以及头足类及苔藓虫 *Eridotrypella* sp. 等化石。(详见剖面图中的分层)

357 米

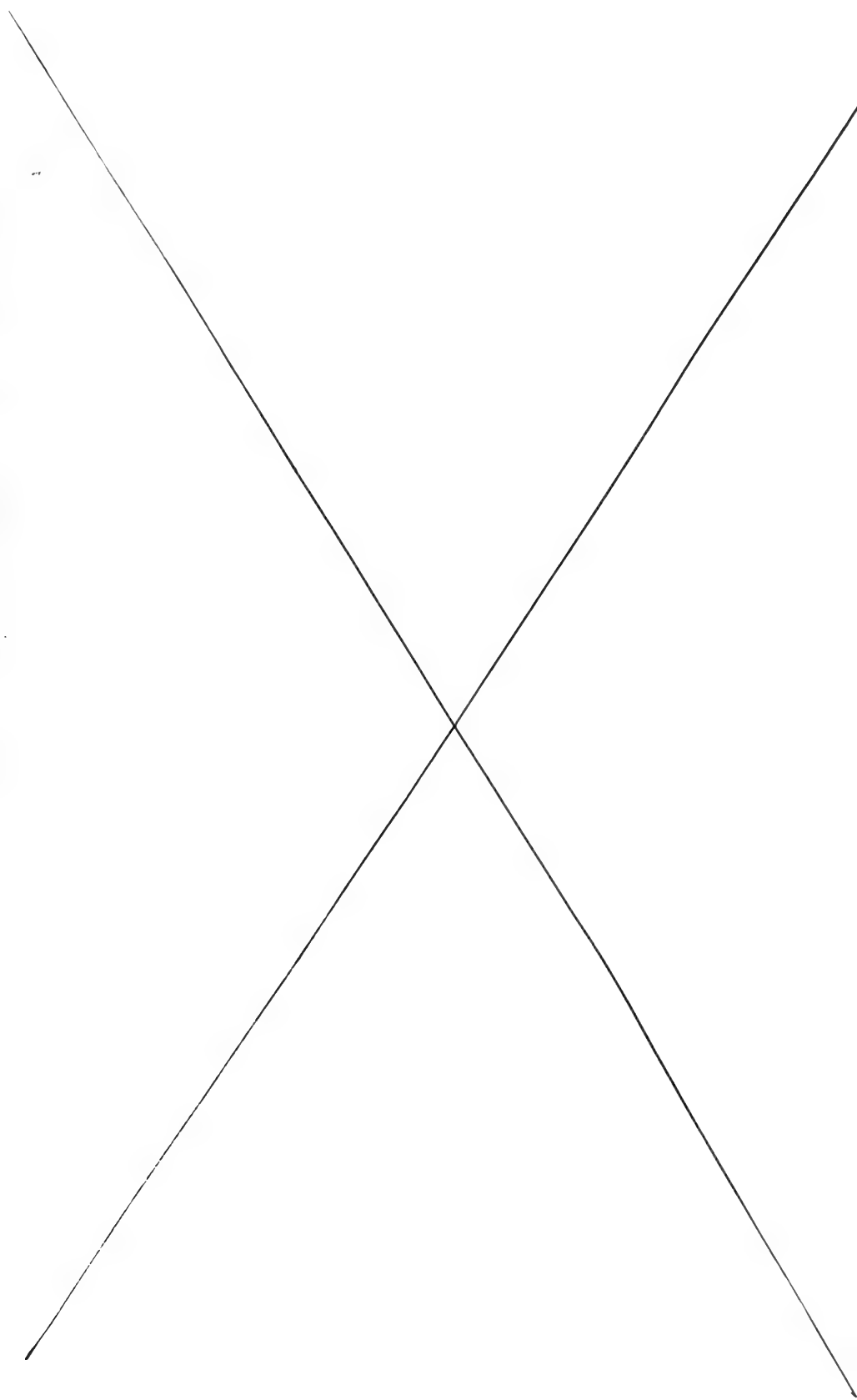
(4) 黑色薄层状瘤状灰岩,含腕足类 (SKP 005) *Cyrtospirifer* sp.

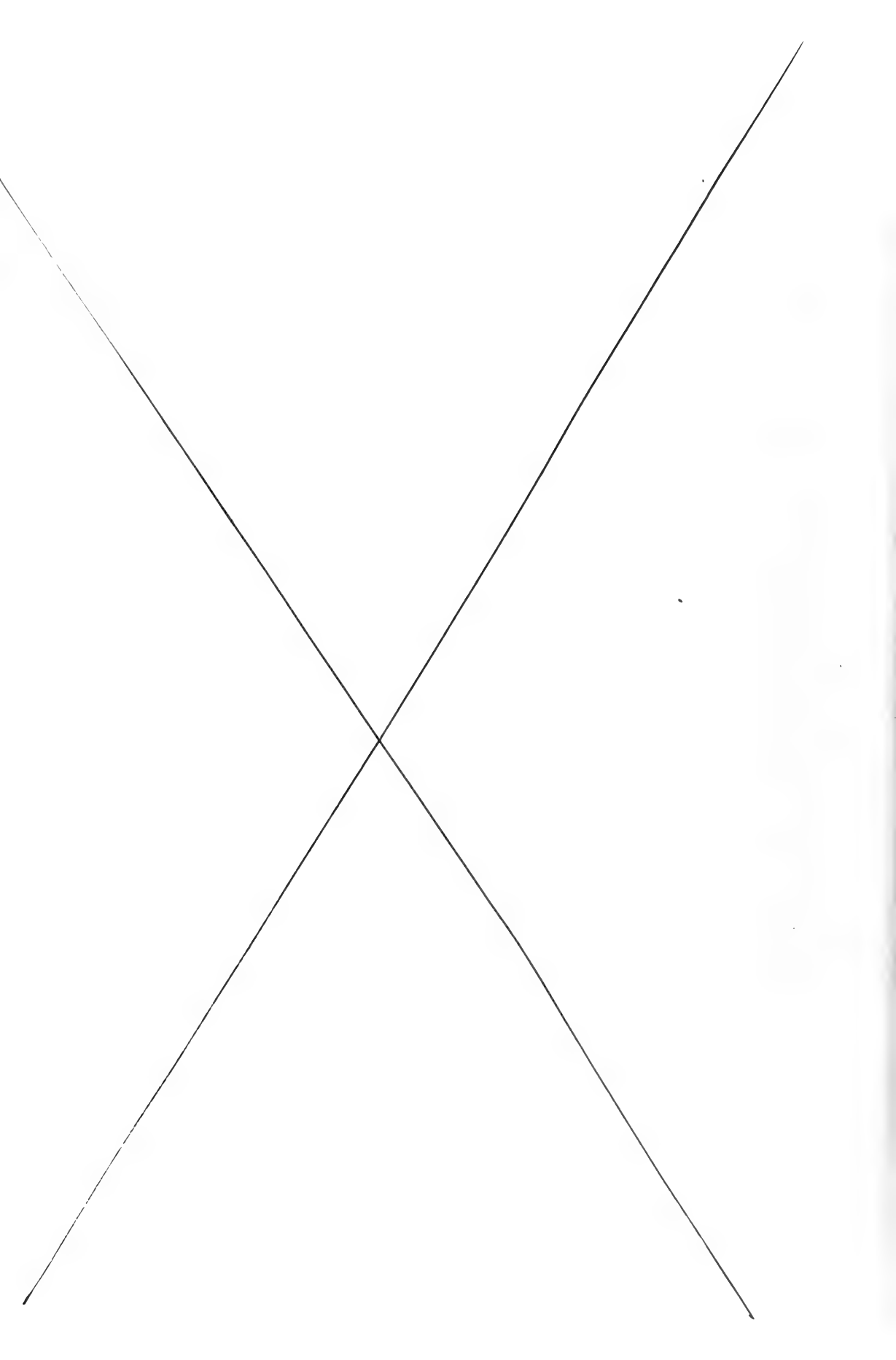
5.5 米

(3) 薄层泥质灰岩夹灰岩扁豆体。

5 米

(2) 黄绿色钙质泥岩与薄层泥质灰岩之互层,含腕足类 (SKP 002—004) *Cyrtospirifer* sp., *Athyris*





sp., *Productella* sp., *Camarotoechia* sp., *Pugnoides* sp., *Yunnanella* sp. 等及苔藓虫、头足类化石。 54米

(1) 薄层深灰色灰岩夹黄绿色页岩数层,灰岩中含腕足类(SK P 001)*Schuchertella* sp., *Camarotoechia* sp., *Cyrtospirifer* sp., ?*Productella* sp. 及苔藓虫 *Atoctotoechus* sp. 等。

——断层接触——

下伏岩层——侏罗系

据王钰同志鉴定腕足类所得结果,认为:*Cyrtospirifer* sp., *Yunnanella* sp., *Yunnanellina* sp., 等,是我国南方上泥盆系的标准化石。因此,以上地层可以和我国南方上泥盆系下部(Frasnian)的地层对比,出露厚度约694米。

在克兹尔山区通古兹布拉克附近整伏于中泥盆系灰岩之上的是一套厚约650米左右的红色、绿色、紫色砂岩片岩层,在砂岩夹含的灰岩凸镜体内富含腕足类化石,经鉴定有*Yunnanella*, *Tenticospirifer*, *Camarotoechia* 等属。时代亦可肯定为上泥盆纪,和砂石山区出露的地层相当。

本区上泥盆系下部(Famenian)的地层前人未曾报导过,因此用砂石山组一名来代表这段地层。

上泥盆系上部? (Famenian)——克兹尔塔克组

在克兹尔塔克西段地质部第13大队发现了一套厚达1600多米的火山喷发岩系整合复于含*Yunnanella*的上泥盆系下部(Frasnian)的地层之上,喷发岩的岩性主要是酸性凝灰岩、凝灰砂岩及砾岩。

由于没有化石证据,我们只能从其和下伏的云南贝层为连续沉积的关系上推断可能属上泥盆纪上部(Famenian)的地层,或可代表泥盆纪末布里顿运动开始阶段的产物;但是,也有可能属于下石炭纪初期的沉积,何去何从,有待今后更深入地研究始能确定。我们把这段火山岩系命名为克兹尔塔克组。

以上是我們对于本区志留泥盆纪地层的分层意见。

另外,我們在干草湖北穿越卡拉塔克的公路两侧观察了一个剖面,这个剖面是諾林的“干沙河系”标准剖面所在地,大致层序如下:

(3) 浅灰色块状结晶质石灰岩,頂未出露,含腕足类 *Brachythyridina* sp., *Dictyoclostus* sp., 苔藓虫 *Fenestella* sp., 珊瑚类 *Lophophyllidium* sp., *Koninckophyllum* sp. 等。 约100米

(2) 绿色及棕灰色千枚状板岩,褶曲剧烈,重复多次出现。 约500米

(1) 浅褐色石英质砂岩,底部为第四纪砂砾层掩盖。 约400米

从灰岩中的化石性质来看,上述地层的时代应属中—上石炭纪。

在干草湖以西苏克-苏克布拉克附近也发现了类似干草湖区的灰岩层,不过变质程度轻微得多,灰岩中找到的化石和干草湖区的几乎完全相同,而且增加了许多 *Syringopora* sp. 等珊瑚化石。此外,在干草湖以西卡拉塔克范围内上述的砂岩、板岩、石灰岩等地层也普遍发育,其中的化石也和干草湖区的相似。

諾林(1941)报告中叙述的干草湖(諾林誤称“干沙河”)区的地层剖面,其岩性和我們观察到的大致相似。由于諾林没有在其中采到化石,只能从岩石性质以及变质程度上把本区的地层勉强地和“阿尔皮斯米布拉克系”中的第2层进行对比,把这里出露的地层命名为“干沙河系”,认为其时代应属志留泥盆纪。虽然諾林在报告中也提到了俄国地质学

家科茲洛夫(Kozlov 1899)曾在这套地层上部的灰岩中找到过若干苔蘚虫化石,但是没有鑑定結果,时代仍然无法肯定。

从我們在以上地层内找到的化石以及在其左右邻近地区观察的結果,足以証明諾林的所謂“干沙河系”絕不能和“阿尔皮斯米布拉克系”相比,只能代表中—上石炭紀的地层。其所以在于草湖区变質程度加深是受了附近的后期火成岩体侵入影响所致,因此干沙河系一名应予取消。

关于諾林在本区創立的喀拉其吉尔杂岩系的时代問題,因为和我們的分层有关,一併在此簡單地討論一下:

喀拉其尔杂岩系(Qara-Qizil Complex)主要出露地点是在庫米什以西的喀拉其吉尔(Qara-Qizil)村附近,根据諾林的报告,这套地层的主要岩性是細粒角質岩、黑云母石英片岩、角閃片岩、蛇紋化片岩、角閃岩、千枚岩以及結晶灰岩。这套变質較深的岩系沿着庫米什以南的山区大致呈北西—南东走向广泛地分布着。

喀拉其吉尔杂岩系的另一个剖面出露在庫米什以南,干草湖以北,即由这套地层組成的阿拉塔克(Ala-Tagh)的高山,也就是地質部的同志們所稱的硫磺山。諾林曾穿过这个地区并繪有簡略的路綫地質图(見諾林,1941年报告第50頁)。根据諾林的意見,本区地层約可分为下列五套:石灰岩砾岩系,蛇紋状片岩系,石灰岩系,千枚岩系,石英斑岩系等,由于其中沒有采获任何化石,諾林也就只能从变質程度、岩石性質以及地理分布上把喀拉其吉尔杂岩系和“阿尔皮斯米布拉克系”相比,认为前者的时代应比“阿尔皮斯米布拉克系”老,可能属于寒武奥陶紀,也可能是志留紀。諾林的工作肯定是比较粗糙的,虽然他沿路綫观察到的岩性和实际地层分布情形大致是符合的,但是其間的許多构造关系未能弄清,地层的层序无法判明,最主要的是沒有化石証据,所以时代涵义也就更为混乱了。

我們在阿拉塔克区工作的結果,对該区地层划分的初步意見,初步澄清了諾林的喀拉其吉尔系的时代含义,其中地层的对比在前面已有討論。諾林的喀拉其吉尔系中的石灰岩层相当于我們的阿尔皮斯米統底部的灰岩层,属于下泥盆紀;片岩及千枚岩以及灰岩—砾岩层包括了我們划分的中志留紀硫磺山統和上志留紀阿拉泰克統以及一部分中奥陶紀的地层,而石英斑岩系应当是本区的火山岩系,我們命名为卡拉塔克統,相当中泥盆紀下部的地层。

| 諾 林 (1940, 1941)                  | 張、 俞、 陸、 張 (1958) |    |             |
|-----------------------------------|-------------------|----|-------------|
| 阿尔皮斯米布拉克系<br>或<br>干沙河系<br>(志留泥盆系) | 克茲尔塔克組<br>砂 石 山 組 | 上統 | 泥<br>盆<br>系 |
|                                   | 派尔薩布拉克組<br>卡拉塔克組  | 中統 |             |
|                                   | 阿尔皮斯米布拉克統         | 下統 |             |
| 喀拉其吉尔补岩系<br>(寒武奥陶系或志留系)           | 阿拉塔克統             | 上統 | 志<br>留<br>系 |
|                                   | 硫 磺 山 統           | 中統 |             |
|                                   | 中 奥 陶 系           |    | 奥<br>陶<br>系 |

此外,根据新疆地质局地层队在喀拉其吉尔系的标准地点,庫米什附近工作的結果,认为那里的地层基本上和阿拉塔克区出露的地层相似。庫米什附近在砂岩夹含的凸鏡状灰岩中也采获了一些志留紀的牀板珊瑚化石。由以上几点說明“喀拉其吉尔杂岩系”的地层包含了从中奥陶紀到中泥盆紀早期的各个时期的地层,时代涵义既然如此之广,关系又不明确,所以喀拉其吉尔系一名实无保留的必要,应予废除。

茲將我們对庫魯克塔克区志留泥盆紀地层的分层意見以及和前人的对比列一簡表如上(見上頁)。

## 2. 柯坪塔克区的志留泥盆紀地层

柯坪区的奥陶紀地层在前一节中已經詳細叙述。在柯坪地台范围内广泛发育在中奥陶紀笔石頁岩之上的是一套厚度相当大的綠色至褐綠色及褐黃色的砂頁岩系,向上漸变为紅綠相間的砂質泥岩,最后全部变为紅色的砂岩层。这套地层的底部和中奥陶系之間在許多地方均有一薄层細砾岩分隔,砾岩层的厚度变化很大,从2米到10余米不等,甚至完全消失。这一套地层的上部在紅色砂岩层之上往往被上石炭系含 *Pseudoschwagerina* 的灰岩呈平行不整合关系所复。茲將我們在柯坪以西苏巴什沟口出露的志留泥盆紀地层剖面的观察結果,結合地质部13大队測制的剖面,綜合起来,分述如下:

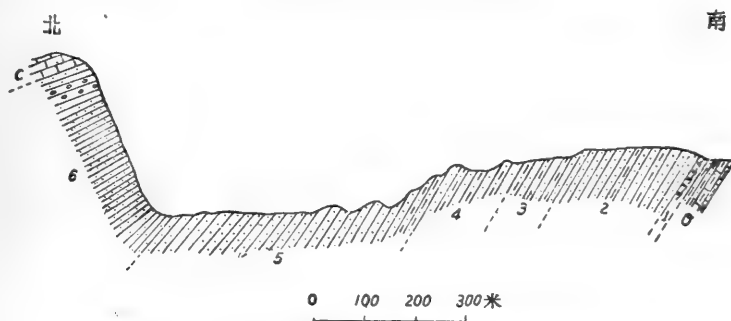


图6. 苏巴什沟口志留泥盆紀地层剖面示意图

- |                          |                  |
|--------------------------|------------------|
| 0. 中奥陶紀鈣質砂岩及砂質泥岩         | 4. 紅綠相間之砂泥岩层     |
| 1. 細砾岩层                  | 5. 紫紅及砖紅砂岩夹砂質泥岩层 |
| 2. 灰綠色細砂岩夹砂質頁岩,砂岩层面具波紋构造 | 6. 砖紅色砂岩夹砾岩层     |
| 3. 黃褐至浅綠色砂岩夹砂質頁岩         | C. 上石炭紀灰岩        |

上复地层——上石炭系

---平行不整合---

(6) 砖紅色部分为白色細砂岩,粉砂岩夹少許灰色砾岩层,砂岩具交錯层理,砂岩成分以石英为主夹少許长石。450米

(5) 紫紅色及砖紅色細砂岩及砂質泥岩夹少許天青色細砂岩条带。400米

(4) 砖紅及浅綠色薄层砂岩、粉砂岩夹砖紅及紫紅色泥岩。本层下部以綠色砂岩为主,上部則漸变为砖紅色砂泥岩。紅色砂岩成分单一,以石英为主,綠色砂岩中除石英长石外,尚有黑色矿物。在本层中下部的紅色砂泥岩中采获少量腹足类及瓣鳃类化石,但是保存极差,无法鑑定。130米

(3) 黃褐至浅灰綠色中厚—薄层状鈣質砂岩夹薄片状砂質頁岩。100米

(2) 灰綠至綠色細砂岩夹砂質頁岩及砂質泥岩,砂岩层面具清晰的波紋构造,下部砂岩顆粒逐步变粗。240米

(1) 細砾岩层, 砾径 10—30 厘米左右

2—10 米

下伏地层——薩尔干系(中奥陶系)

柯坪地区上述这一套紅色及綠色的砂泥岩层, 以往由于沒有在其中得到足够的化石証据, 前人的分层意見也就很不一致。

諾林 (1937, 1941) 及其以前的某些地質学家們如格魯柏 (1914) 和喀达尔 (Keidel, 1906) 等都曾經把上述的地层甚至包括下部的中奥陶紀泥灰岩层归入石炭系或中石炭系內, 統称为庫魯克烏苏木 (Quruqsum Complex) 統, 其下的中奥陶紀石灰岩层被誤認為是下石炭系而紅砂岩上部的紡錘虫灰岩层則把它置于下二迭系底部称为康克林 (Kankerin) 灰岩。

自从1935年以来苏联的許多地質工作者們曾經在天山区域进行过比較詳細的地質調查工作, 对本区的地层划分上作出了許多貢獻。其中值得特別提及的是西尼村的工作, 西尼村对本区志留泥盆紀地层划分的意見在他的許多有关的著作中均有所討論 (1948, 1957……)。西尼村把本区出露的綠色砂頁岩层包括其下的含笔石頁岩及泥灰岩层以及上部的紅綠相間的砂質泥岩层都划作志留—泥盆系, 統称为柯坪塔克系, 并且自上而下分作三組; 在底部的泥灰岩中西尼村曾找到腹足类 *Poleumita* aff. *alata* (Hisinger) 認為应属志留紀, 中部的綠色砂頁岩层属于中—上泥盆系, 其中曾采获类似 *Straparellina* 的腹足类化石, 上部的紅綠相間的砂泥岩属于上泥盆系至下石炭系杜南統, 頂部的紅色砂岩层則属于下石炭紀杜南統与其上的“維宪”期灰岩, 按西尼村的意見是平行不整合接触 (詳閱西尼村 1957, 44 頁)。西尼村划分的柯坪塔克系底部的頁岩中我們已經采获了笔石化石, 証明实属中奥陶紀, 至于中上部的地层, 我們将在下面詳細討論。

1955—1957 年地質部 13 大队在本区进行 1/20 万比例尺的地質測量工作期間, 对本区的地层划分工作奠定了良好的基础。按照地質部 13 大队的意見, 本区的志留泥盆紀地层可分作以下各个单位:

|               |              |
|---------------|--------------|
| 柯坪塔克岩系 (S-D)  | } 沙拉依姆岩系 (D) |
| 塔泰尔塔克岩系 (Dtt) |              |
| 依木崗塔烏岩系 (Di)  |              |
| 克紮尔塔克岩系 (Dk)  |              |

上述各分层所依据的标准剖面地点是在沙拉依姆区。

13 大队分层中的柯坪塔克系相当于我們剖面中的第 (1—3) 层, 按地質部的意見属于志留—泥盆系; 塔得尔塔克系相当于我們剖面中的第 (4) 层, 而依木崗塔烏系和克茲尔塔克岩系則分別可和我們分层中的第 (5) 第 (6) 层相当, 按照地質部 13 大队的意見, 这三套地层都属于泥盆系总称沙拉伊姆系。

我們基本上同意地質部第 13 大队的分层意見, 并作下列几点补充:

1. 我們同意把紅色砂岩地层划作下石炭紀以前的地层, 理由是: 在柯坪以北烏什以西沙法尔拜依村西南附近的山沟中可以清楚地看到下石炭系的底砾岩层不整合地超复于紅綠砂岩层之上。底砾岩中普遍含有下部地层中紅綠砂岩及石灰岩的砾石成分。这里, 紅色砂岩及其下的綠色砂岩层厚度驟增; 至于砾岩层的时代已为其上的黑色灰岩中采获的化石所証明, 其中有 *Kueichowphyllum*, *Dibunophyllum*, *Arachnolasma* 等以及 *Giganto-*



*productus* 等标准的下石炭纪珊瑚、腕足类化石。

2. 绿色砂页岩系地层在柯坪区以北，岩相稍有变化，其中夹含少许灰岩凸镜体，在乌什以西沙法尔拜依附近的灰岩凸镜体中曾采获一块牀板珊瑚化石，經我們鑑定为 *Propora* sp. 是志留纪的产物。

1956年地质部 13 大队在柯坪山柯坪塔克系的砂岩中采获了一些珊瑚化石，經我們鑑定有 *Codonophyllum*, *Plasmopora*, *Propora* 等属，时代肯定属志留纪无疑。

于是我們就有足够的证据可以认为柯坪区的上述绿色砂页岩层应属志留系，13 大队命名的柯坪塔克岩系的时代，也就应该属于志留纪。

3. 从沉积物性质及其沉积环境上来分析柯坪区绿色砂页岩层之上的红色砂岩层，实代表不同的沉积环境下的产物。说明志留纪浅海还原环境下沉积绿色岩系之后，柯坪地台继续上升，海水愈益变浅继而退出，沉积环境开始由原来的还原环境逐渐过渡到陆相的氧化环境，于是沉积物的性质也就相应地由红绿相间的砂泥岩逐渐变为砖红色的砂岩沉积。

上述沉积环境的“骤然”改变，反映在沉积物性质上的较大变化，我們认为是可以据以作为划分时代的条件的。此外，在柯坪以西 400 多里的霍什布拉克区发现了厚达 1200 多米的中泥盆纪海相砾岩及灰岩沉积，在灰岩中，我們采获了许多腕足类及苔藓虫等化石，其中的腕足类經王钰同志鑑定有下列各属：*Atrypa*, *Grünwaldtia*, *Calvinaria*, *Cypidula*, *?Adolfia*, *?Schizophoria*, *?Stenosisma* 等。从地质部第 13 大队在这一带调查的结果，看来很可能上述的海相地层向东在普昌地区与柯坪区的红砂岩层的西延部分相接，二者为相变的关系。

综上所述，我們认为柯坪区绿砂岩之上的红色地层有理由划归泥盆系，我們也同意采用地质部 13 大队的塔得尔塔克统一名代表志留纪与泥盆纪间过渡阶段沉积的岩层或代表泥盆纪初期的沉积，即相当于红绿色砂岩及砂泥岩的沉积。但是在没有足够的化石证据以前，我們认为没有必要把泥盆纪地层划分得如此详细，我們建議保留 13 大队的沙拉依姆统一代表柯坪地台上相当于塔得塔克统以上的整个泥盆纪地层。其时代暂定为中上泥盆纪。

为了明瞭起见，茲將我們的分层意見及和前人的比較列一簡表如下：

| 格 魯 伯 (1914)<br>諾 林 (1942) |                   | 西 尼 村<br>(1957)     | 地 質 部 第 13 大 队<br>(1955—1957年) |                | 張、俞、陸、張<br>(1958) |         |
|----------------------------|-------------------|---------------------|--------------------------------|----------------|-------------------|---------|
| 下 二 迭 紀<br>Kankerin 灰 岩    |                   | 下石炭紀維宪統<br>(海百合莖灰岩) | 石 炭 二 迭 紀<br>(平 行 不 整 合)       |                | 上 炭<br>石 紀        | 康克林灰岩   |
| 中<br>石<br>炭<br>紀           | 紅色砂岩系             | 下石炭系杜內統<br>(紅色砂岩层)  | 泥<br>盆<br>紀                    | 沙姆<br>拉岩<br>伊系 | 中<br>泥<br>盆<br>紀  | 沙拉伊姆統   |
|                            | 綠色砂泥岩系<br>(平行不整合) | 泥 盆 系<br>(綠色砂頁岩系)   | 志<br>留<br>泥<br>盆<br>紀          | 柯坪塔克岩系         | 下<br>泥<br>盆<br>紀  | 塔得尔塔克統  |
| 下<br>炭<br>石<br>紀           | 泥灰質岩系             | 奧 陶 系               | 奧<br>陶<br>紀                    | 薩 尔 干 系        | 中<br>奧<br>陶<br>系  | 薩 尔 干 統 |

### 3. 結 語

天山南麓志留泥盆紀地层从沉积单元的性质上看来基本上可以归納为两种类型：一为地台型，一为地槽型或接近于地槽型。各个沉积单元中的地层发育情况無論在沉积物的性质、厚度以及岩性变化上均有显著的差异。因此，我們就不可能任意以某一地点的地层剖面来概括某一区甚至整个南天山的地层发育情况，必需从分析各个沉积单元的性质上来詳細研究其中的地层发育特征。

塔里木古陆西北緣柯坪地区的志留泥盆系，属于陆緣浅海相至陆相的沉积。說明柯坪地台在中奥陶紀末期开始不断地上升，上升的过程是平稳而緩慢的，因而中奥陶系团块状灰岩沉积之后随着海水的緩慢退却逐渐沉积了含笔石的泥灰岩及頁岩层。

志留紀之前柯坪地台上发生了短暫的沉积間断，表现在志留系底部有細砾岩的沉积，地台上升的过程是比較平稳而緩慢的，沉积間断过程也比較短暫，所以細砾岩的厚度也就不大。

志留紀期間柯坪地台仍然不断上升着，海水繼續退却，于是在还原环境下，沉积了綠色的砂岩层，局部地区由于海水較深，在比較清靜的水底尚繁殖少数生物，个别地区尚出現含珊瑚的石灰岩体。加里东运动在柯坪地台范围内影响不大。泥盆紀期間柯坪地台仍然保持不断的上升过程。海水愈益变浅，繼而退出地台区域，沉积环境开始由原来的还原环境逐步过渡到陆相的氧化环境，于是沉积物的性质也就相应地由原来的綠色砂岩經過紅綠相間的砂泥岩沉积逐渐过渡到相当厚的砖紅色砂岩沉积。

下石炭紀至中石炭紀期間，柯坪地台上未接受任何沉积，而在其北部，即地質部第13大队划出的木茲杜克岩相帶內(馬灘以北、烏什以西所見情形)，沉积了巨厚的下石炭紀砾岩及灰岩层。柯坪地台在中石炭紀之末开始下沉，上石炭紀海水浸淹，沉积了上石炭紀的紡錘虫灰岩。

塔里木古陆东北部庫魯克塔克区域内，截至目前为止，尚未发现志留泥盆紀地层。可以这样推論：庫魯克塔克区在中下奥陶紀之末，即已隆起成陆，此后一直保持上升及侵蝕的状态，未接受任何沉积。綜上所述塔里木古陆北緣無論在东部和西部，中奥陶紀以后普遍发生隆起，而以东部上升較快，并且一直保持上升过程，西部上升过程比較緩慢，并在中石炭紀之末一度下沉。

南天山地槽帶內，志留泥盆紀地层发育的情况就截然不同。这里的沉积物厚度驟增，岩相变化非常复杂，而且时有海底的火山噴发造成巨厚的噴发岩系。

南天山地槽帶西部，志留泥盆系发育情况可以喀什北部的地层剖面作为标准。苏联地質保矿部第13航测大队曾在該区进行过1/20万比例尺的区域地質測量工作，对該区的地层划分工作奠定了基础。我們虽然也曾經在該区进行了短期的观察，但因受時間的限制，对13大队的分层提不出更新的意見。根据13大队的报告，該区的志留泥盆系可作如下的划分：

上复地层——下石炭系

~~~~~不整合~~~~~

上泥盆系下部(D<sub>3</sub>)：深灰色及灰色泥質片岩与灰岩互层。

400—700米

灰岩中有 *Megaphyllum paschiense* Soshk., *Schluteria fasciculatus* Soshk., *Jowaphyllum*, *Phillipsastraea filata* Schloth., *Petalotrypa* 等

中泥盆系上部 ( $D_2^{ei}$ ): 总厚 400—450 米

上部深灰至浅灰色中厚层至厚层灰岩。 200—250 米

灰岩中含标准的中泥盆系上部的化石。如 *Stringocephalus aff. burtini* Defr., *Pentamerus brevinosteris* Phill., *Temeniophyllum poshiense* Wang, *Disphyllum*, *Neospongophyllum*, *Stratipora*, *Alveolites* 等

下部为黑色及深灰色泥质絹云母片岩夹薄层灰岩。 200 米

中泥盆系下部—上部 ( $D_2^{ef-gi}$ ):

下部絹云母石英片岩,上部浅灰色灰岩及泥质灰岩之互层。 总厚 350—400 米

灰岩中含腕足类、珊瑚化石。如 *Productus suboculatus* Murch., *Atrypa duosi* Vern., *Sinospongophyllum planotabulatayoh*, *Spirifer mucronatus* Corr., *Productella spinulicostata* Hall 等。

下泥盆系—中泥盆系下部  $D_1-D_2^{ef-gi}$ :

上部: 深灰色层理不明的灰岩夹黑色燧石层,灰岩中含 *Pseudomicroplasma*, *Coenites*, *Stratipora*, *Squmeofavosites* (?) sp., *Pachyfavosites* ex. gr. *polymorpha* (Goldfuss) 等珊瑚化石。

400 米

中部: 絹云母片岩及凝灰砂岩底为中—粗粒复矿砂岩。 600 米

下部: 黑色砂质絹云母片岩。 厚 500—700 米

~~~~~ 不整合 ~~~~~

上志留系 ( $S_{Ldw-dt.}$ )

上部: 粉砂岩及片岩互层夹灰岩凸镜体含 *Squmeofavosites*, *Favosites* ex. gr. *hisingeri*, *Heliolites*, *Syringopor* 等珊瑚化石。

1000 米

中部: 砂质片岩及粉砂岩层 200 米

下部: 酸性喷发岩系。 250 米

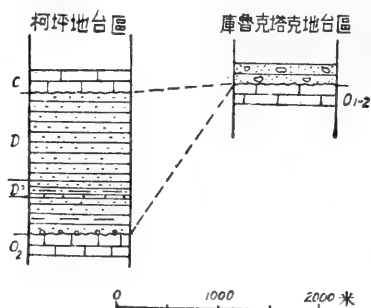
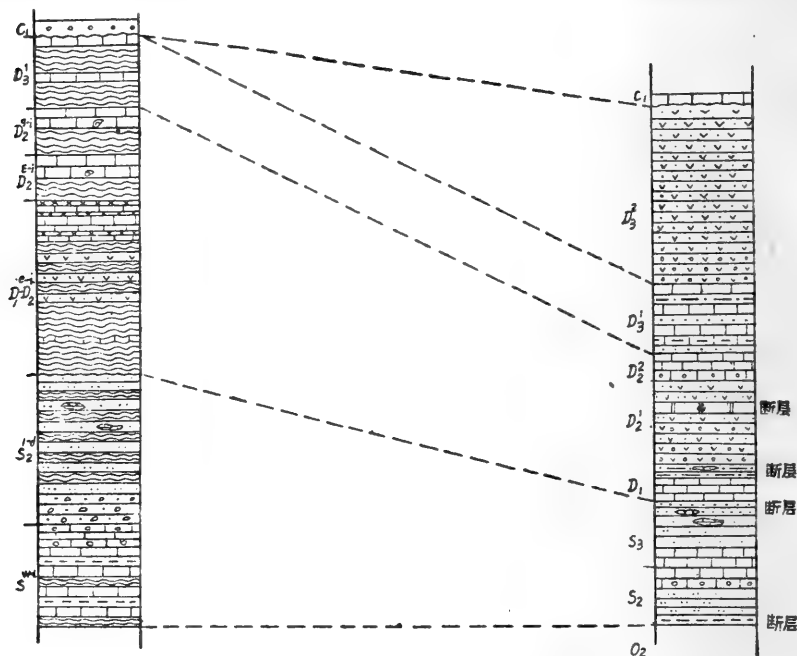
志留系中上部 ( $S_{Wenl.-Lud.}$ ) 暗灰色灰岩与絹云母千枚岩及綠泥石片岩互层,上部为灰岩与石灰砾岩层的互层。

总厚 1000 米

南天山东段庫魯克塔克区志留泥盆系发育情形在前节中已经詳为討論。由于东、西两个地区的剖面都是綜合的,断层褶曲的破坏使各个时期的地层未能出露完全,所以二个地区的地层的确切对比目前还没有条件。但是,总的来看上述二地区的志留、泥盆紀地层还是有着許多共同之处: 首先,在沉积物的性质上,基本上是近似的,例如志留紀的沉积,两地均为变质的砂页岩系近似复理式的沉积;其次,两个地区的各个时期的动物羣的性质也是大同小异,十分接近的;看来在中下泥盆紀期間,两个地区都普遍有着海底的火山喷发活动,沉积有火山岩系。由此足以說明天山南麓地槽区内,在志留泥盆紀期間,东、西海水是互相沟通的。两个地区所处的沉积环境也是基本上类似的。庫車以北发现类似上述两地区的志留泥盆紀沉积,更可以提供这方面的証据(詳閱 13 大队报告)。

南天山地槽西段喀什西北地區  
(据第十三航測大隊資料)

南天山地槽東段  
庫魯克塔克區



圖

例



凝灰砂岩



酸性噴岩



砂岩夾灰  
岩透鏡体



各种礫物成  
份的片岩



石灰岩夾  
燧石层



石灰-砂岩层

(其餘各类岩性圖例均按“普查需知”規定)

图 7. 天山南麓志留泥盆紀地层柱状对比表

### (三) 石炭二迭纪地层部分

#### 1. 庫魯克塔克区

庫魯克塔克区上古生代地层非常零星，主要出露在破城子以北地区。由于受构造和后期火成岩侵入作用影响，地层大都遭受变动，很难找到完整剖面。

过去有很多人在这一带进行过工作，其中以諾林(1937, 1941)的工作比較詳細，他把本区的石炭系及二迭系划分为下列几个单位：

石炭二迭紀——破城子系

上石炭紀——苏巴什系

下石炭紀——覺罗塔克系及努古斯布拉克系

解放以后，地質部 13 大队和新疆地質局(1955—57)在这里开展大规模的地质测量和矿区普查工作。13 大队将本区石炭系及二迭系从上而下划分为四个地层单位：

石炭二迭系 (C-P)

上石炭系 (C<sub>3</sub>)

中石炭系 (C<sub>2</sub>)

下石炭系 (C<sub>1</sub>)

这些地层主要分布在卡拉塔克及克茲尔塔克的东部和西部。

这次作者等也随 13 大队第 6 中队在卡拉塔克及克茲尔塔克一带测制了一部份剖面。从野外工作和室内化石鑑定結果来看，二迭紀地层在庫魯克塔克区是否存在尚有疑問。

在諾林命名为破城子系的标准地点的灰岩中找到珊瑚类化石 *Syringopora*。据野外观察，此套主要为各色的杂砂岩、噴出岩、鈣质頁岩和石灰岩的地层似乎是属于石炭紀的沉积，亦即破城子系属于石炭紀的可能性較大。而破城子的剖面不好，又无法正确代表本区的石炭系。

在克茲尔塔克东北部派尔薩布拉克附近发现一套厚达 1500 米以上的岩系，岩性主要为灰岩、砂頁岩夹砾岩，下为断层接触，上与侏罗系呈角度不整合。在灰岩中曾找到 *Kueichouphyllum* sp., *Productus* sp., *Fenestella* sp. 等化石，故这一套岩系的时代应属石炭紀。

在卡拉泰克 1720 山以北的剖面中，石炭紀地层可分为上、下两部份：下部为浅灰色泥灰岩及薄层灰岩，厚約 300 米，产头足类化石 *Muensteroceras* sp.，其时代属下石炭紀；上部为黑色块状灰岩，产珊瑚及腕足类化石，厚 200 米左右，时代可能属中上石炭紀。

关于諾林定为志留泥盆系的干沙河系的时代已在上面討論过。在其标准地点于草湖的剖面中，找到珊瑚类：*Lophophyllidium* sp., *Koninckophyllum* sp.；腕足类：*Brachythyrina* sp., *Dictyoclostus* sp. 及苔藓虫类：*Fenestella* sp. 等化石，其时代应属石炭紀。

諾林命名的覺罗塔克系、努古斯布拉克系及苏巴什系的标准地点均在此次工作区外，未曾前往工作，无法进一步討論。根据諾林所列的化石名单来看，覺罗塔克系无疑是属于下石炭紀。

由于本区地层出露零星，化石保存少，无法詳細划分地层。作者等同意 13 大队对本区石炭系划分为下、中及上石炭系三部分。

- (3) 上石炭系: 灰色、棕色灰岩和浅灰色、红色石英砂岩互层 800 米  
 (2) 中石炭系: 灰色、灰白色块状灰岩, 夹少量瀝青灰岩, 含腕足类化石 250—300 米  
 (1) 下石炭系: 深灰色及黑色瀝青质砂化灰岩, 夹黄褐色透镜状砂岩, 产 *Muensteroceras* sp.,  
*Productus* sp., *Spirifer* sp., *Syringopora* sp. 等化石 厚约 1000 米

## 2. 柯坪塔克区

柯坪塔克区石炭纪及二迭纪地层出露完整, 构造简单, 化石保存丰富。过去很多人在这里进行过较详细的工作, 其中诺林 (1941) 在柯坪县西北苏巴什一带测制了较详细的地层剖面, 他将石炭系及二迭系从上而下划分为四个单位:

- 下二迭纪——卡伦达尔层 (Kalender)  
 下二迭纪——巴立克立克层 (Baliqliq)  
 下二迭纪——康克林层 (Kankarin)  
 石炭纪——库鲁克乌苏木层 (Quruqusum)

解放以后, 地质部和石油部在柯坪塔克地区作了更大面积的工作。其中以 13 大队工作范围较广, 他们将柯坪区石炭系及二迭系从上而下划分为五个岩系:

- 下二迭纪别良金岩系——灰绿色砂岩、泥岩、泥灰岩互层 2000 米以上  
 上石炭纪一下二迭纪木兹杜克岩系——灰岩及泥灰岩, 富含纺锤虫、珊瑚、腕足类及苔藓虫类等化石 675—1000 米  
 中—上石炭纪苏格丹岩系——灰绿色粉砂质泥质页岩和绿灰色页岩、砂岩等互层, 未见化石 675 米  
 下一中石炭纪别根塔乌岩系——灰色、石英砂岩和砾岩, 夹泥质灰岩及薄层灰岩, 含腕足类及珊瑚等化石 200—1130 米  
 下石炭纪巴什素岩系——灰褐红色砾岩夹红色粉砂岩及灰岩, 未见化石 最大厚度可达 400 米

上列的地层名称都是 13 大队新创立的。他们将新疆柯坪区划分为三个岩相带, 由南而北依次为北塔里木地台型、木兹杜克过渡型及麦旦塔克地槽型。并认为不同类型地区所出露的地层也完全不同。

西尼村 (1957) 在其所著“新疆天山西北部”一书中, 将柯坪区划分为塔里木相 (柯坪地台) 和地槽相 (木兹杜克带), 并对石炭纪及二迭纪地层作了如下的划分:

### 柯坪地台石炭系及二迭系

- 上二迭系: 棕红色、灰黄色泥灰岩、粉砂岩、砂岩及含 *Wentzelella subtimorica* Huang 的灰岩 30—70 米  
 下二迭系: 灰绿色细砂岩及砂岩, 产 *Callipteris* sp. 150 米  
     玄武岩及基性凝灰岩 30 米  
     黑色灰岩, 夹石灰质板岩, 产 *Dictyoclostus gangtzeensis* Chao 20 米  
     浅白色灰岩, 产 *Pseudoschwagerina beedi* Dunbar et Skinner, *Marginifera sintanensis* Chao, *Stylidophyllum denticulatum* Huang 15 米  
 上石炭系: 浅灰色灰岩及钙质砂岩, 产 *Tetrataxis* sp. 及 *Quasifusulina* sp. 10 米  
     灰色、灰黑色钙质砂岩、泥灰岩及薄层灰岩, 产 *Triticites* spp., *Ozawainella* sp.

|   |           |
|---|-----------|
| 中石炭系：浅灰、灰黄色灰岩，产 <i>Chonetes flemingi</i> Norw. et Pratt   | 16 米      |
| 下石炭系（維宪期）：灰色含海百合茎灰岩   | 2 米       |
| ~~~~~ 不 整 合 ~~~~~   |           |
| 下石炭系（杜内期）：紅色具交错层砂岩及砾岩   | 350 米     |
| 木茲杜克带石炭系及二迭系  |           |
| 上二迭系：灰綠色石英質及石英长石質砂岩、粉砂岩及灰黑色頁岩，产植物化石碎片   | 300—400 米 |
| 下二迭系：灰白、灰黄色块状灰岩，产 <i>Marginifera sintanensis</i> Chao, <i>Echinoconchus punctatus</i> Mart., <i>Pseudoschwagerina beedi</i> Danbar et Skinner | 800 米     |
| 上石炭系：灰黑色薄层灰岩及浅灰色块状灰岩，产 <i>Chonetes pygmaeus</i> Loczy   | 150 米     |
| ~~~~~ 不 整 合 ~~~~~   |           |
| 下石炭系（維宪期）：灰色灰岩  | 300—400 米 |
| ~~~~~ 不 整 合 ~~~~~   |           |
| 下石炭系（杜内期）：灰色石灰質及杂质砾岩  |           |

石油部新疆石油局（1958）将柯坪区古生界地层单独划分出来，并着重指出柯坪地台的沉积情况与天山其他地区完全不同。他們认为柯坪地台区仅有石炭紀沉积，总厚約 1000 米，从上而下可分为三层：

- (3) 砂岩及泥岩层
- (2) 腕足类化石层
- (1) 紡錘虫石灰岩层

上列三层的时代认为均屬上石炭紀。

这次作者等同北京地质勘探学院楊式溥同志一起在柯坪县西北苏巴什、馬滩一带及烏什县以西沙法尔拜依附近测制了几个石炭二迭系剖面，并采集了不少化石，对地层的划分有了一些新的認識。由于地层出露的情况不同，作者等同意把柯坪区划分为两个构造单元，即柯坪地台及木茲杜克带。茲將我們所测的剖面分別叙述如下：

#### 柯坪地台区石炭二迭系剖面

柯坪地台区仅出露上石炭紀至二迭紀地层，完全缺失下及中石炭紀地层。上石炭系与泥盆紀紅色砂岩呈假整合接触。以柯坪县西北苏巴什附近剖面为代表，石炭二迭紀地层在这里呈北东东—南西西走向，傾向北西，傾角  $22^{\circ}$ — $25^{\circ}$ 。岩层走向大致与山脉延长方向相同。在这里，整个上石炭系一二迭系总厚达 1090 米，上与第四紀(?)疏松岩层呈角度不整合接触。

上复地层——第四紀(?)地层

~~~~~ 不 整 合 ~~~~~

上二迭紀——卡倫达尔统

- |                                                                      |       |
|----------------------------------------------------------------------|-------|
| (20) 黄色中厚层砂岩，組織疏松，每层厚約 20 厘米                                         | 250 米 |
| (19) 黄紅色中厚层砂岩与黄綠色砂質泥岩互层，前者每层厚約 20—30 厘米，后者每层厚約 5—20 公分，两者形成很多小的沉积旋迴。 | 500 米 |
| (18) 黄色薄层 鈣质砂岩与黄色砂质泥岩互层，砂岩中含腹足类及瓣鳃类化石碎片                              | 50 米  |

下二迭紀——巴立克立克统

- (17) 灰黑色薄层灰岩，每层厚 4—5 厘米，石燕貝化石极多，均分布在层面上，并产

- 苔蘚虫 *Fistulipora* sp. 13.5 米
- (16) 黑色不純泥質灰岩, 风化面呈純黃色, 产腕足类及腹足类 *Bellerophon* sp. 5.5 米
- (15) 微紫紅色厚层灰岩, 每层厚 5—10 厘米, 頂底部有一白色薄层介壳灰岩, 頂部介壳灰岩厚 25 厘米, 底部介壳灰岩厚 2.9 米, 产苔蘚虫 *Fistulipora* sp., *Streblascopora* sp. 13.89 米
- (14) 黑色中厚层灰岩, 每层厚約 25 厘米, 产瓣鳃类: *Sanguinolites* sp., *Allorisma* sp., *Aviculopecten* sp. 苔蘚虫: *Fistulipora* sp., *Streblascopora* sp., *Meekopora* sp., *Rhombo-*  
*pora* sp., *Streblotrypa?* sp. 2.78 米
- (13) 灰色薄层泥灰岩, 夹白色薄层介壳灰岩, 泥灰岩中产苔蘚虫类: *Rhabdomeson*  
sp., *Fenestella* sp. 18 米
- (12) 微紫紅色薄层灰岩与灰黑色炭質頁岩互层, 灰岩中富产苔蘚虫类: *Streblascopora*  
sp., *Rhabdomeson* sp., *Ascopora* sp., *Streblotrypa* sp., *Fenestella* sp. 5.94 米
- (11) 灰黑色中厚层灰岩, 每层厚达 50 厘米, 产苔蘚虫类: *Streblascopora* sp., *Streblotrypa?* sp.,  
*Ascopora* sp., *Rhabdomeson* sp., *Fenestella* sp., *Dybowskiella* sp. 44.71 米
- (10) 中厚层不純灰岩, 每层厚 20—30 厘米, 上部为灰色, 下部为黑色, 間夹黑色炭質頁岩 27.64 米
- (9) 黑色致密灰岩 19.39 米
- (8) 深灰色中厚层致密灰岩, 底部具有同心圈状組織, 向上漸少, 化石集中于頂部 5.8 米的灰岩中, 产瓣鳃类: *Schizodus jakovleir* Fedotov, *Allorisma* sp.; 腕足类: *Dictyoclostus* sp., *Dielasma* sp., *Echinoconchus* sp., *Cancrinella* sp., *Marginifera* sp., *Notothuris* sp., *Phricodorchyris* sp. 39.73 米
- (7) 灰紅色致密含鉄質砂岩, 底部为一层厚 0.5 米灰綠色砂岩 20 米
- 上石炭紀——康克林統
- (6) 灰白色薄层生物灰岩, 組織疏松, 化石丰富, 主要为筴科化石, 风化后化石隨地可拣, 形似砂粒。化石有筴科类: *Schwagerina longa* Kireeva, *S. cf. compa* Thompson, *S. aff. campensis* Thompson, *S. aff. pedisqua* Viso., *Paraschwagerina aff. gigantea* (White); 苔蘚虫: *Sulcorestepora* sp., *Uniotrypa* sp.; 腕足类: *Terebratuloida* sp. 38.12 米
- (5) 浅灰綠色鈣質砂岩夹薄层灰岩, 产筴科化石 38.13 米
- (4) 灰白色薄层至中层灰岩, 产筴科类: *Schwagerina aff. emaciata* (Beede), *S. cf. baehkhirica*,  
var. *acuminata* Kireeva, *S. sp.*, *Ozawainella* sp., *Schubertella* sp. 14.67 米
- (3) 灰色薄层泥質灰岩夹鈣質頁岩 1.8 米
- (2) 灰白色薄层灰岩, 底部微帶紫紅色, 产筴科类: *Triticites cf. creekensis* Thompson, *T. mogto-*  
*vensis* Rosovskaya, *Schwagerina cf. conspecta* Shamov et Scherbovich, *S. cf. compa* Thompson, *Pseudo-*  
*schwagerina cf. beedei* Dunbar et Skinner 19.94 米
- (1) 褐紅色砾状灰岩, 灰岩中产筴科化石 4.0 米

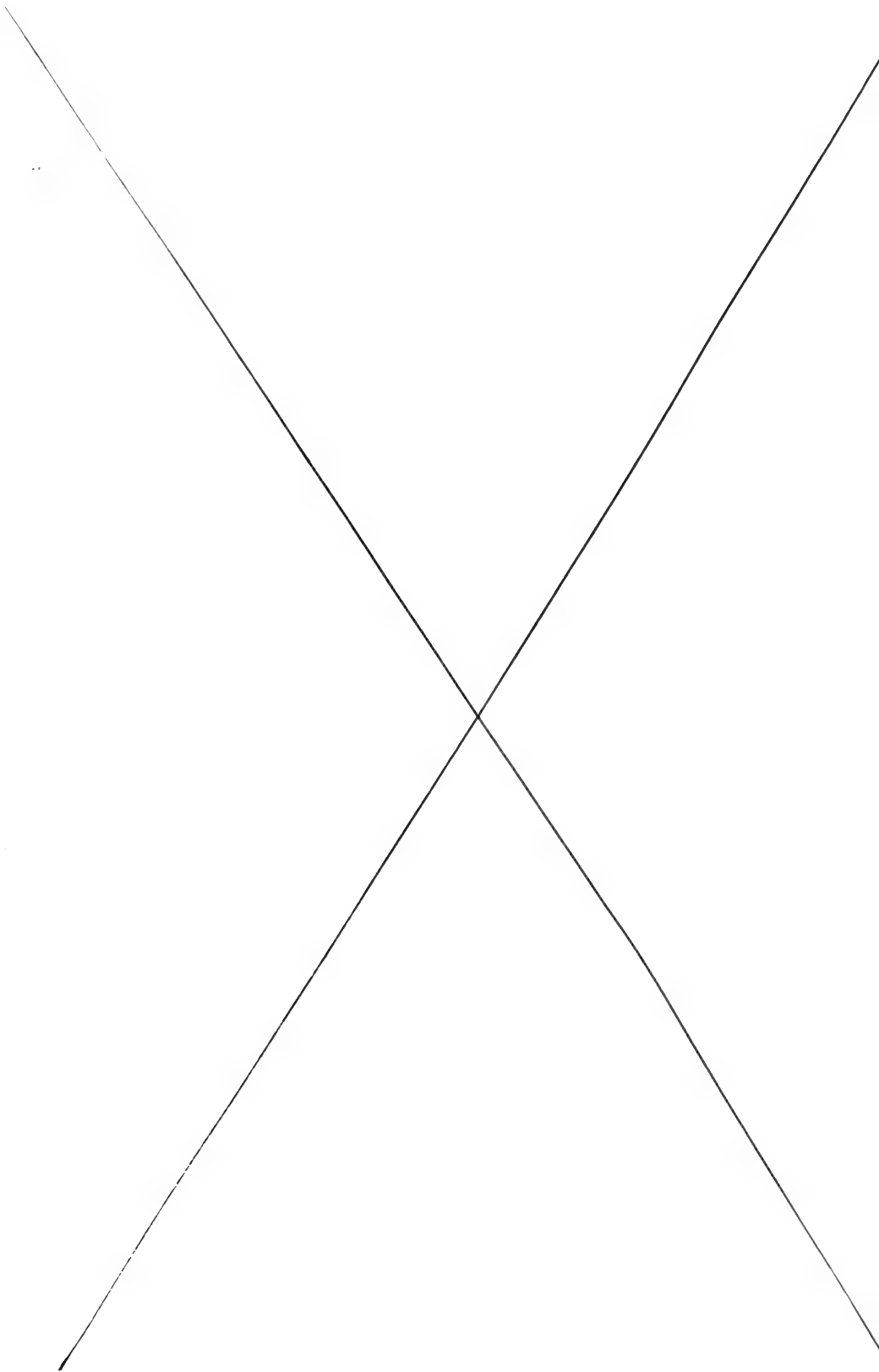
---- 假整合 ----

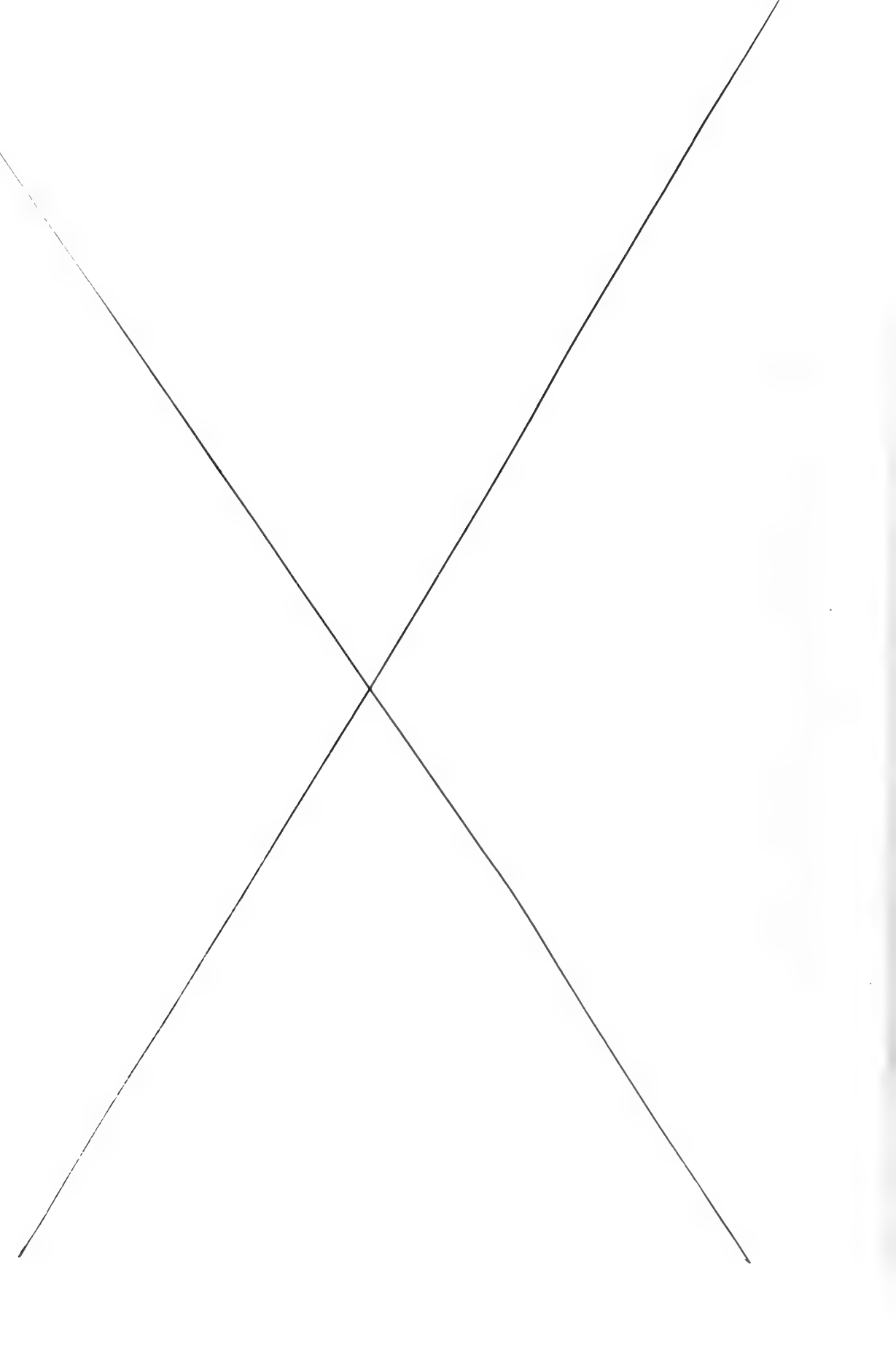
下伏地层——泥盆紀紅色砂岩

上述剖面中, 第(1)—(6)层与諾林(1934)所测剖面中的康克林层相当。第(7)层与諾林剖面中的粘土层相当。第(8)—(17)层相当他剖面中的巴立克立克层, 第(18)—(20)层則与他剖面中的卡倫达尔层相当。

康克林灰岩中富产筴科化石, 其中如 *Pseudoschwagerina*, *Triticites* 等更是中国上石炭紀地层中的标准帶化石。因此康克林灰岩的时代和中国东南的船山灰岩、西南的馬平灰岩以及中国北方的太原統相当, 也应属于上石炭紀。







第(7)层是含鉄质砂岩,未曾发现任何化石,和其下的康克林灰岩之間看不出什么显著的間断,和其上的巴立克立克灰岩第(8)一(17)层也是渐变关系。巴立克立克灰岩中沒有发现任何筳科化石,只有腕足类 *Dictyoclostus*, *Dielasma*, *Marginifera* 等,这些都是二迭紀的分子,我們主張把第(7)层的含鉄质砂岩和其上的灰岩即巴立克立克灰岩作为一个单位看待,称为巴立克立克統,归于下二迭紀。含鉄质砂岩系代表巴立克立克灰岩底部的陆相沉积,和中国南部棲霞灰岩底部的棲霞底部煤系情况相仿。

卡倫达尔系按諾林原来的意見,将其归入二迭紀。我們这次并没有采到足以說明地层时代的化石,根据諾林当初所采到的植物化石經赫勒(Halle)定为 *Callipteris* sp. 的一个标本,最近送請斯行健教授并和他討論結果,他認為可能是一新种,这个标本和一般下二迭紀的种有很大程度的不同,斯教授完全同意我們把产有这个 *Callipteris* sp. 的卡倫达尔层划归上二迭紀。从沉积上說,卡倫达尔統和其下的巴立克立克統也有显著不同,即巴立克立克統是海相沉积,而卡倫达尔統是純陆相沉积。因此,我們把卡倫达尔統暂时划归为上二迭紀,希望今后能有更多的化石采集和研究来加以証实和修正。

紅色砂岩的时代在上面志留泥盆系一节已予討論,这一套缺失化石的紅色岩系属于泥盆紀的沉积,似乎沒有多少疑問。

石油部新疆石油局(1958)划分柯坪地台上古生代地层的三层,与康克林統、巴立克立克統及卡倫达尔統的层位分別相当。但石油局認為三层的时代均屬上石炭紀,作者等認為柯坪地台区实有二迭紀的沉积。

西尼村(1957, p.70)归为下石炭紀杜內期的紅色砂岩与作者等这次划为泥盆紀的沙拉伊姆系相当,下石炭紀維宪期的灰岩至下二迭紀含 *Pseudoschwagerina* 属的灰岩則与上石炭紀康克林統相当。西尼村归为下二迭紀含 *Dictyoclostus* 的灰岩則相当巴立克立克統,玄武岩层及其上含 *Callipteris* sp. 的粉砂岩及砂岩层則与卡倫达尔統相当。必需指出,西尼村所測剖面中的地层厚度則較作者等所見者为小。

### 木茲杜克帶石炭二迭系剖面

木茲杜克帶石炭二迭紀地层与柯坪地台区情况不同,在这里,下、中石炭紀地层也有出露,下二迭紀巴立克立克統的岩性为砂頁岩与灰岩互层。这次我們在烏什县以西沙法尔拜依村附近測制了石炭系剖面,而在柯坪县馬滩一带測制了中石炭一二迭系剖面,茲分述如下:

#### (1) 沙法尔拜依村附近石炭系剖面

沙法尔拜依村位于烏什县以西 100 余里,剖面位在公路之一側。在这里,石炭紀地层因受构造影响,大都为断层接触。

上复地层——上石炭紀灰岩层

—·—断层接触—·—

上石炭系:灰白色块状石灰岩,产筳科化石 *Triticites* sp., *Pseudoschwagerina* sp., *Schwagerina* sp. 50 米

中石炭系:黑色炭质頁岩,灰色頁岩夹数层薄层灰岩,未获化石

140 米

—·—断层接触—·—

## 下伏地层——上石炭纪灰岩层

从上述剖面中知道,中石炭系指一套頁岩夹数层薄层灰岩层。在薄层灰岩中未找到任何化石,但根据13大队在1956年寄来古生物所要求鉴定的同一地点的标本中,则产有中石炭纪的筴科化石 *Fusulina* cf. *nytvica* Saf., 因此我们暂将这一套岩系置于中石炭纪。

上石炭纪地层在沙法尔拜依村附近仅出露一部分,其上部因断层而缺失,由于在灰岩中找到富产于中国东南部馬平灰岩、华北太原統中的化石,故其时代应归上石炭纪。

在上述剖面以东的公路旁,見下石炭纪地层零星出露。其下与奥陶纪地层呈断层接触,上为浮土层复盖。下石炭系由下部砾岩层,上部灰岩层共二层組成。总厚約45米。下部砾岩的砾石成分不一,主要为石灰岩、燧石、变质岩碎块、石英及紅色砂岩碎块等組成。砾石大小不一,最大达40厘米。渾圓,胶結物为石灰質,出露厚度約15米。上面灰岩层,厚約30米,产珊瑚及腕足类化石 *Kueichowphyllum* sp., *Dibunophyllum* sp., *Arachnolasma* sp. 等。此套岩系在喀什以东巴什索貢一带发育最为完整,13大队曾命名为巴什索貢系,与下伏地层呈不整合接触。

## (2) 柯坪县馬滩一带石炭二迭系剖面

馬滩位于柯坪县境内,属木茲杜克带之最南緣。在这里出露中石炭纪一二迭纪地层,上与第三纪砾岩层呈明显的角度不整合。二迭纪为砂頁岩系作北北东南南西走向,傾向南东,傾角 $45^\circ$ 。而第三纪砾岩层的傾角仅 $20^\circ$ 左右。在砾岩的砾石中发现筴科化石。

## 上复地层——第三纪砾岩层

~~~~~角度不整合~~~~~

## 上二迭系:

- |                                   |       |
|-----------------------------------|-------|
| (8) 黄綠色砂質頁岩                       | 40 米  |
| (7) 土黄色层状砂岩与褐綠色頁岩互层               | 130 米 |
| (6) 土黄色、褐綠色薄层砂岩与土黄色鈣质泥岩互层,产植物化石碎片 | 30 米  |

## 下二迭系:

- |   |        |
|---|--------|
| (5) 土黄色薄层灰岩与薄层砂岩互层,在灰岩中产苔蘚虫类: <i>Streblotrypa</i> sp., <i>Fenestella</i> sp., <i>Fistulipora</i> cf. <i>sinensis</i> Yoh; 腕足类: <i>Squamularia</i> sp. | 72.5 米 |
|---|--------|

## 上石炭系:

- |   |         |
|---|---------|
| (4) 浅灰色中层灰岩,产筴科化石   | 60 米    |
| (3) 灰白色块状灰岩,在地形上形成陡壁,产筴科 <i>Triticites</i> sp., <i>Pseudoschwagerina</i> sp. 及腕足类化石 | 約 120 米 |
| (2) 灰白色薄层灰岩,产苔蘚虫类 <i>Fenestella</i> sp., <i>Septopora</i> sp.                       | 2 米     |

## 中石炭系:

- |                               |        |
|-------------------------------|--------|
| (1) 褐色薄层砂岩夹灰黑色頁岩,风化成碎块,仅出露于山坡 | 約 35 米 |
|-------------------------------|--------|

上述剖面中的第(1)层为砂頁岩系,未見灰岩存在,时代确定的根据系按上下层序,其上即为含上石炭纪化石的灰岩。与沙法尔拜依剖面大致可以对比。第(2)–(4)层为富含上石炭纪筴科化石的灰岩,可与柯坪地台区康克林統相对比。第(5)层与柯坪地台区巴立克立克統相当。第(6)–(8)层则与苏巴什剖面中卡倫达尔統相当。

上述两个剖面说明在木兹杜克带中发育下石炭纪至中石炭纪地层。地质部 13 大队 (1957) 曾将这里的下、中石炭纪地层命名为巴什索贡岩系 ( $C_1^{bs}$ )、别根塔乌岩系 ( $C_1^{bt}$ ) 及 苏格丹岩系 ( $C_1^{sd}$ ) 三部分, 并认为苏格丹岩系有一部分可能属上石炭纪。从野外测量结果与 13 大队所命名的地层对比, 作者等, 认为沙法尔拜依剖面中下石炭纪砾岩和灰岩层与 13 大队命名的巴什索贡岩系和别根塔乌岩系相当, 时代属下石炭纪。沙法尔拜依及马滩二剖面中暂置于中石炭纪的岩系相当于苏格丹岩系, 时代属中石炭纪。因此作者等建议巴什索贡岩系及苏格丹岩系两名称, 应予保留, 代表木兹杜克带下、中石炭纪的沉积。

木兹杜克带上石炭纪一二迭纪地层完全可以与柯坪地台区对比, 也可分为康克林统、巴立克立克统及卡伦达尔统三个地层单位, 所不同者只巴立克立克统的岩性在两地稍有差异而已。

综上所述, 似可拟一对比表如下:

|     |   | 张日东、俞昌民、陆麟黄、张遵信(1958) |        | 诺林 (1941)         | 13大队(1955—57)    |
|-----|---|-----------------------|--------|-------------------|------------------|
|     |   | 柯坪地台                  | 木兹杜克带  |                   |                  |
| 二迭纪 | 上 | 卡伦达尔统                 | 卡伦达尔统  |                   | 别良金岩系            |
|     | 下 | 巴立克立克统                | 巴立克立克统 | 卡伦达尔层巴立克立克灰岩康克林灰岩 |                  |
| 石炭纪 | 上 | 康克林统                  | 康克林统   | 库鲁克乌苏木组           | 木兹杜克岩系           |
|     | 中 | 缺失                    | 苏格丹统   |                   | 苏格丹岩系            |
|     | 下 | 缺失                    | 巴什索贡统  |                   | 别根塔乌岩系<br>巴什索贡岩系 |

### 3. 西崑崙山区

这里所指的西崑崙山区系 1957 年 13 大队工作区, 地理座标为北纬  $36^{\circ}55'$ — $38^{\circ}00'$  东经  $76^{\circ}15'$ — $78^{\circ}00'$  之间, 适位于西崑崙的弯曲地带, 过去称为莎车弧。西崑崙山区的地层过去很少有人研究, 仅知道特拉(H. Terra, 据 A. W. Grabau, 1932) 在提士纳夫河谷及桑株河谷等地进行过路线测量和采集了一些化石, 他将石炭系及二迭系从上而下划分为几个地层单位:

下二迭系:

上部: 灰色与绿色粗粒砂岩, 夹钙质页岩与介壳灰岩含植物化石 *Calamites* sp. 及腕足类

*Marginifera lopingensis* 等化石

100 米

下部: 浅灰色灰岩, 含 *Schwagerina* (= *Pseudoschwagerina*) *princeps* 等化石

92 米

上石炭系:

浅灰色灰岩, 含 *Productus graciosus* 等化石, 底部为 2—6 米厚之云母砂岩

厚约 72—76 米

中石炭系:

石灰岩,含 *Fusulinella bocki* 等化石 110 米  
下石炭系——提士納夫統

紅紫色长石砂岩,砾岩及噴出岩 約 100 米

1956—57 年地質部 13 大队在本区进行二十万分之一地質測量,根据沉积条件及构造特征,他們将本区划分为两个构造相带,即地槽带和地台带。并将石炭二迭紀地层自上而下划分为五个地层单位:

上二迭系:

上层——黃綠色砂岩頁岩夹薄层灰岩,灰岩中含化石 510 米

中层——紫紅色砂岩及粉砂岩夹薄层石灰岩 140 米

下层——灰岩,砂岩及頁岩互层,有順层侵入之輝綠岩 470 米

上石炭—下二迭系:

含紡錘虫、腕足类及珊瑚等化石之石灰岩 300—507 米

中—上石炭系:

石灰岩、砂岩、黑色炭質頁岩,含珊瑚及腕足类化石 約 400 米

下石炭系:

石灰岩、石英砂岩、白云岩为主,含化石 150—190 米

泥盆—下石炭系

紅色砂岩及粉砂岩,找到鱗木化石 838 米

这次在莎車县以西卡兰烏依和漢德若作者等測制了二个石炭二迭系剖面,現分述如下:

### 卡兰烏依石炭系剖面

卡兰烏依于棋盘河的上游,距棋盘約 40 里。在这里,前石炭紀地层及二迭紀地层也有出露,由于我們未測制剖面,故仅討論石炭紀地层。石炭紀地层在卡兰烏依附近走向近乎东西,向北傾斜,傾角几近直立。

上复地层——二迭系

——断层接触——

上石炭系:

(7) 浅灰色块状結晶灰岩,富含球状构造及簕科化石 (SKQ 577—582) *Triticites* sp., *Quasifusulina* sp., *Pseudoschwagerina* sp. 120 米

(6) 灰白、灰色厚层結晶灰岩,产簕科化石 (SKQ 567—576) *Triticites* sp., *Quasifusulina* sp. 約 100 米

中石炭系:

(5) 暗紅色鈣質砂岩夹浅灰色薄层灰岩,灰岩中产簕科化石 *Pseudostaffella ozawai* (Lee et Chen), *Fusiella typica* Lee et Chen 70 米

(4) 灰黑色薄层炭質頁岩、砂岩与浅灰色薄层灰岩互层,灰岩中产簕科类: *Profusulinella parva* (Lee et Chen), *Profusulinella* sp. 珊瑚类: *Caninia* sp., *Dibunophyllum* sp. 80 米

下石炭系:

(3) 浮土复盖 約 100 米

(2) 浅灰色中层鲕状灰岩 15 米

(1) 浮土复盖 約 50 米

## 下伏地层——泥盆纪红色砂砾岩系

上述剖面中,第(1)–(3)层仅见到鲕状灰岩的出露,无法确定其正确的时代,仅根据上下层序,暂将此3层归入下石炭纪,以待今后更详细的观察和找寻化石予以补充和修正。第(4)–(5)层可与特拉在提士纳夫河谷一带所划分的上石炭纪地层相当。第(6)–(7)层则相当于特拉划分的上石炭系及下二迭系下部之和。

从化石的性质上来看,卡兰乌依所含的 *Pseudostaffella*, *Fusiella*, *Profusulinella* 等化石是中国中石炭纪地层中的标准化石,因此卡兰乌依中石炭纪灰岩的时代与中国东南的黄龙灰岩、西南的威宁灰岩以及华北的本溪统相当,也属于中石炭纪。

同样,含 *Triticites*, *Quasifusulina*, *Pseudoschwagerina* 等化石的灰岩可与柯坪塔克区康克林统对比,时代属上石炭纪。

## 濮德若石炭二迭系剖面

本处在构造上为一背斜层,地层最老为中石炭系。这次所测剖面,仅在背斜的一翼。在这里,地层走向作北北西—南南东,倾向北东,地层倾角愈新愈陡。

## 上复地层——侏罗纪砾岩

~~~~~角度不整合~~~~~

## 上二迭系:

(5) 黄绿色、紫红色砂岩与頁岩互层

約 200 米

## 下二迭系:

(4) 浅灰色致密状灰岩与砂岩,炭质頁岩互层,灰岩中产腕足类及腹足类化石 (SKQ 558—560)

*Cancrinella* sp., *Marginifera*? sp., *Buxtoria* sp., *Dictyoclostus* sp.

120 米

## 上石炭系:

(3) 浅灰白色厚层结晶灰岩,产䇇科化石 (SKQ 546—550) *Triticites* sp., *Schwagerina* sp.

70 米

(2) 浅灰色薄层灰岩,产䇇科化石: *Triticites* sp., *Quasifusulina* sp., *Rugosofusulina* sp., *Schwagerina* sp.

41 米

## 中石炭系:

(1) 浅灰色薄层灰岩,夹炭质頁岩及砂岩,灰岩中产化石 (SKA 526—535) 䇇科类: *Fusulinella pseudobocki* Lee et Chen, *Pseudostaffella sphaeroidea* (Ehrenberg), *Fusulina schellwieni* (Staff); 珊瑚类: *Lophophyllidium* sp.; 腕足类: *Choristetes* sp., *Striatifera*? sp.

厚約 78 米

上述剖面中,第(1)层与卡兰乌依剖面中第(5)层相当,第(2)–(3)层则相当該剖面中的第(6)–(7)层。第(4)层为海陆交替相,和其下的上石炭纪灰岩之間看不出显著的間断,和其上的純陆相沉积的砂岩、頁岩层(第(5)层)也是渐变关系。在第(4)层中沒有发现任何䇇科化石,只有腕足类如 *Cancrinella* sp., *Marginifera*? sp., *Buxtoria* sp., *Dictyoclostus* sp. 等,这些化石同柯坪塔克区下二迭纪巴立克立克統中所产者非常相近,因此我們主张把这一套海陆交替相含腕足类化石的岩系归入下二迭纪,而与巴立克立克統对比。第(5)层由于未曾发现任何化石,它的正确时代难以确定。从沉积上說,它和其下的下二迭系有所不同,即本层为純陆相紫红色,黄绿色砂岩与頁岩互层。因此,我們把这一套岩层暂时划归上二迭纪,与柯坪塔克区卡倫达尔統相当,希望今后能采集到化石来加以証实。

## ПАЛЕОЗОЙСКАЯ СТРАТИГРАФИЯ ЮЖНОГО ПОДНОЖИЯ Г. ТЯНЬ-ШАНЬ В СИНЬЦЗЯНЕ

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### (Резюме)

С мая до октября 1957 г., чтобы содействовать экспедиции № 13 Министерства геологии в её стратиграфической и палеонтологической работе, мы отправились в район южного подножия Тянь-Шань в Синьцзяне на работу на срок полу-года.

Теперь данный отчет о работе выделен по следующим трём областям.

### Область Курук-Таге

Нижнепалеозойские отложения обнажаются на южной и юго-западной частях этого района и разрезы более полные, ископаемые богатые.

#### 1. Кембрийская система.

Разрез находится на склоне горы Мохур-Шань южнее Поченцы.

Вышепокрывающие отложения—серия Чарчак (нижнего ордовика)

—согласный контакт—

Верхнекембрий—Турсуктагский отдел  $Cm_3^f$  215.8 м.

Среднекембрий—Мохур-Шаньский отдел  $Cm_2^m$  165.5 м.

Нижнекембрий—Сидашаньский отдел  $Cm_1^f$  125.4 м.

.....псевдосогласный контакт.....

Нижнележащие отложения—серия Курук-Таге (синийского периода).

(1) Сидашаньский отдел ( $Cm_1^f$ ) в основании которого представлены наиболее мощностью 50 м фосфриты, в средней части—прослой черных кремней, кверху постепенно появляются тонкослоистые известняки, среди которых встречаются трилобиты: *Palaeolenus*, *Redlichia*?, плеченогие: *Obolella* sp.; древние морские кабели маленького типа: *Protospongia* и другие.

(2) Мохур-Шаньский отдел ( $Cm_2^m$ ) состоит из светлосерых, тонко-среднетолстослоистых известняков с меньшим количеством коричневых и бурых кальциевых сланцев, в которых собраны всего 19 пластов с окаменелыми трилобитаем, среди них имеются: *Dorypyge*, *Hepagnostus*, *Goniagnostus*, *Fuchouia*, *Peronopsis*, *Lejopyge*, *Ptychagnostus* и другие.

(3) Турсуктагский отдел ( $Cm_3^f$ ) состоит из темносерых толстослоистых известняков, среди которых собраны всего 15 пластов с окаменелыми трилобитами.

Такие как: *Pseudagnostus*, *Charchaia*, *Agnostus*, *Hedinaspis*, *Lopnorites*, *Proceratopyge* и т. д.

Среди выше указанных трех стратиграфических единиц кембрия, исключая отдела Тршак-Таге, названного Нориным, а остальные два единицы на этот раз были установлены по новым названиям. В данных разрезах развита фауна трило-



битов, большинство родов которых очень похоже на кембрийскую фауну в Европе и в южном и юго-западном районах Китая, поэтому в районе Курук-Таре кембрийская фауна следует отнести к фауне Атлантического океана (Atlantic Province).

## 2. Ордовическая система.

Ордовические отложения этого района были названы Нориными сериями Чарчак и Тушик-Булак, среди которых найдены ордовические окаменелые граптолиты: *Didymograptus* cf. *supertus* Lapworth, *Climacograptus scharenbergi* Lapworth и другие ископаемые нижнего ордовика, как плеченогие: *Eoorthis*? sp.: головоногие: *Protohal-toceras qurugense* Troedsson, *P. holmi* Troedsson; трилобиты: *Geragnostus kobayashii* Troedsson, *Asaphus* sp., *Sumardia congifrons* Troedsson и другие. Только в области г. Люхуан-Шань и южнее Трекайз-Тане от неё мы нашли ордовические отложения, горные породы, на основании которых являются зелеными песчаниками, филлитами и песчаными конгломератами, в средней части породы — зелеными крепкими с меньшим количеством тонкослоистых известняков, в верхней части — фиолетово-красными известняками, глинистыми сланцами, среди которых имеется большое количество стеблей морских линий, головоногих, кораллитов и т. д. Они определены следующими: *Troedssonoceras* sp., *Michelinoceras* sp., *Corbyoceras* sp., *Discoceras* sp., *Sinoceras rudum* Yü; кораллитами: *Protozaphrentis minor* Yü и т. д. Ещё выше находятся сланцы лентохлоритов, доломитов, кварцитов, граниты, гранитные гнейсы, песчаники со светлокрасными полевыми, шпатами, крепкие зернистые песчаники и брекчиевидные известняки. Общая мощность примерно определяется в 1500 м.

Исключая содержащие ископаемые отложения, которые утвердительно отнесли к среднему ордовика, а в их нижней части ещё найдены брахиопода; *Atrypa desquamata* Sowerby, поэтому в ней могут быть существованы верхние отложения среднедевонской системы.

## 3. Силур-девонская система.

Силур-девонские отложения широко обнажаются в области севернее Сингер. Серия почти метаморфическая и развивается со складками и разрывами.

Среднесилурская система — Серия Люхуан-шань: обнажается около г. Люхуан Шань, верхняя часть состоит из известковых конгломератов мощностью 70 м которые представлены собой непрерывным соотношением с вышележащими верхнесилурскими отложениями: нижняя часть — зелено-серых и светлобурых песчаных алевролитов с телами двояковыпуклой линзы известняков, содержащих коралловые ископаемые: *Favosites* sp. и *Plasmopora* sp. и т. д. в основании (среднесилурской системы) представлены песчаники с зеленым филлитом мощностью 350 м, которые находятся в сбросном контакте с нижележащими среднеордовическими отложениями.

Верхнесилурская система — Серия Ала-тад выходит в районе Аратак, в их нижней части находятся серобелые и темносерые тонкослоистые, а даже кускообразные известняки, содержащие коралловые ископаемые: *Kyphophyllum* sp., *Cystiphyllum* sp. cf. *Mucela* sp., *Squameofavosites* sp., *Heliolites* sp., *Favosites* sp., и другие. мощность — 274.3 м.

Верхняя часть состоит из зеленоватых и фиолетовых алевролитов с прослоями филлитов, в составе алевролитов содержатся линзы известняков, мощность её составляет 367.85 м.

Нижнедевонская система обнажается около ключа Ала-тал и Арпишемеву-лик.

Нижняя часть наблюдается зелеными лейтохлоритами, кварцеватыми и бурыми кальциевыми песчаниками, даже алевролитами с тонкослоистыми прослоями линз черных известняков, содержащими кораллиты ?*Pachyfavosites* sp., *Thaumnopora* sp., ?*Breviphyllum* sp. и т. д.

Средняя часть состоит из белых толстослоистых и кусковых известняков

Верхняя часть состоит из тонкослоистых среднеслоистых известняков с прослоями желто-зеленых подзолистых песчаных глин, среди которых богатые ископаемые плеченогие и кораллиты, а именно, плеченогие: *Grunewaldtia* sp., *Uncinulus* sp., *Schuchetella* sp., *Leptaena* sp. и другие; кораллиты: *Pseudomicroplasma* sp., *Rhizophyllum* sp., *Leptoinophyllum* sp., *Squameofavosites* sp., *Heliolites* sp. 229.78 м.

Средний девон.

Нижняя часть: Кратагский отдел ( $D_1^1$ ) обнажается в области Ала-таг, Мощность—около 500 м. Этот отдел находится на сбросном контакте наверху с отложениями Юры и внизу с отложениями ордовика и представлен вулканическими эффективными сериями, состоящими из туфовых песчаников и туфовых конгломератов, в туфовых песчаниках имеются тела линзы известняков с ископаемыми плеченогими: *Atrypa desquamata*.

Верхняя часть: Парсабулакский отдел ( $D_2^1$ ) расположена в возвышенности 1539, примерно 40 км западнее от Ганьцаоху и 12 км юго-западнее от Парсабулак. Её отложения сильно складчатые и повсюду метаморфические, мощность составляет около 250 м. Она представлена толстослоистыми и тонкослоистыми известняками и среднеслоистыми глинистыми мергелями, в них содержатся кораллиты: *Temeniophyllum waltheri* Yoh, *Wedekindophyllum* cf. *corneolum* Wdkd., *Thaumnopora* sp., *Stratipora* sp., плеченогие: *Atrypa* sp., ? *Conchidium* sp. и другие. Нижняя граница отдела Парса-булак не ясна. Наверху он имеет контакт с продолжительными осадками девона.

Верхний девон.

Нижняя часть. Шашишаньский отдел ( $D_3^1$ ) выходит значительно лучше в районе г. песчатых камней, около 9 км северо-западнее Парса-булак, гна преимущественно состоит из темносерых тонкослоистых глинистых известняков с желтозелеными тонкослойстыми песчаниками и сланцами, среди известняков богато содержатся плеченогие: *Yunnanella* sp., *Yunnanellina* sp., *Cyrtospirifer* (= *Sinospirifer*) sp. и т. д. Мощность обнажения составляет 694 м.

Верхняя часть: Кызылтагский отдел ( $D_3^2$ ) представлена вулканической серией, состоящей из туфовых песчаников и конгломератов, среди которых не были найдены ископаемые, возраст её ещё не определен.

Норин огульно назвал отложения силурдевонской системы данного района Арписмядуракской системой или Ганьшахэской системой. По нашему расчленению стратиграфии, это название уже не годится и надо аннулировать.

Силур-девонские отложения данного района по характеру осадок, по степени метаморфизма, повидимому, нужно отнести к осадкам геосинклинального типа их можно сопоставить с выемчатыми осадками геосинклинали в западном и среднем участках Южных Тянь-Шань.

#### 4. Карбонная система.

Около Парсабулак от Кызыл-Таг встречается серия в целом мощностью более 1500 м известняков, песчатых сланцев с конгломератами; верхняя часть проявляет несогласные контакт с юрскими отложениями, а нижняя часть находится в сбросовом контакте, в известняках развиваются ископаемые: *Kweichouphyllum*, *productus*, *Fenestella* и т. д. возраст её отнесен к карбонной системе.

Кроме того, в упорном разрезе Ганцаоху, названном Нориным Ган-Шахэской свитой силур-девана были найдены карбонные ископаемые кораллиты: *Lophophyllidium*, *Koninskophyllum*; плеченогие: *Brachythyrina*, *Dictyoclostus*; мшанки *Fenestella*, поэтому название свиты Тан-Шахэ следует аннулировать.

Во время нашей командировки не было видно обнажение, отнесенное к пермским отложениям.

### Кэлпинская область

Кэлпинская область включает многие моноклинальные холма с единодушными структурами, например, Кэлпин, Имган-Тау, Озьтар-Тау и другие, разрез отложений полный.

#### 1. Кембрийская система.

На этот раз мы видели кембрийские отложения в овраге Бешкал-Таг 5 км. севернее от Субаши. Нижняя часть преимущественно состоит из комплекса пестрых песчаников, сланцев, глин с прослоями солей и гипсов, она имеет мощность примерно 1000—1200 м. Вследствие неполного обнажения, их контакт с нижнележащими отложениями не ясен; средняя и верхняя части преимущественно состоят из мощность 300—400 м. темносерых доломитов и известняков, среди которых не было обнаружено ископаемых; девятое отделение экспедиции № 13 Министерства геологии обнаружило хорошо обнажающиеся кембрийские отложения, находящиеся около Сугейт-булак севернее от кельпина, и нашло новый род семейства трилобитов *Redlichiiidae* нижнего кембрия. Возраст их соответствует низам отдела Цанляньпу, приближается к отделу Цзечжусу.

Комплексные разрезы отложений данного района (сверху вниз) залегают:

Вышележащие отложения—Чуритакская свита (нижнего ордовика)

—согласный контакт—

Аватагеский отдел (Cm)<sup>1v</sup>.

(4) Темнокрасные алевролиты с прослоями мергелей, доломитов и гипсов; самая верхняя часть состоит из пересливаний мергелей и доломитов. Мощность 130—250 м.

(3) Тонкослойные доломиты, кусковые известняки с прослоями желтых мергелей, а также содержащие толщу гипсов, в нижней части тонкослойных доломитов развиваются ископаемые трилобиты: новые роды (пока ещё не названы). Мощность 220—240 м.

(2) Серые и темносерые разнослойные доломиты, в составе их содержатся прослой черных известняков, кремнистых и углистых сланцев, в известняках развиваются ископаемые трилобиты: *Redlichiiidae*—новый род семейства. Мощность 280—340 м.

(1) Нижняя часть состоит из темнокрасных песчаников, сланцев; верхняя часть—серо-белые кварцеватые песчаники, сланцы; в нижней части имеется

один неравнотолстой слой конгломератов. Мощность 400—920 м.

~~~~~угловое несогласие~~~~~

Нижнележащие отложения—протерозой и синийского периода, представлены сланцеватыми пластами и песчанистыми сланцами.

По характерам пород отложений данного разреза и содержащимся в них ископаемым, первая и вторая толщи следуют отнести к нижнему кембрию, третья и четвертая толщивозможно к среднему и верхнему кембрию.

## 2. Ордовическая система.

Измеренный нами разрез ордовических отложений находится в устье оврага Су-баши в 15 км северо-западнее уезда Кэлпина, обнажение отложений полное, в которых ископаемые богаты.

Вышележащие отложения—кэлпинская свита (ордовика)

-----параллельное несогласие-----

Средний ордовик—сарганский отдел( $O_3^f$ ) 217 м.

Нижний ордовик—чультагский отдел( $O_1^f$ ) 244.5 м

——согласный контакт——

Нижнележащие отложения—серия Аватак (кембрия)

(1) Чультагский отдел ( $D_1^f$ )—в её верхней части представлены серозеленые узловатые известняки и бурсерые толстослоистые известняки; в нижней части—бурсерые, кремнистые известняки с меньшинством доломитов, в этой толще были собраны всего 4 пласта с ископаемыми, а именно, головоногие: *Endoceras lui* Yü, *Richardsonoceras* sp., *Vaginoceras* sp., *Armenoceras* sp., *Sectoceras* sp., *Cyrtendoceras* sp., *Ortoceras* sp., *Cyrtoceras* sp., *Polygrammoceras lineatum* (His.), *Pseudorthoceras* sp., *Plectronoceras* sp.; трилобиты: *Ptychopyge* sp., *Isotetoides* sp., *Illaenus* sp., *Nileus* sp., *Nileus* aff. *armadillo* Dalman; гостроподы: *Ophileta* sp.; *Bucania* sp., *Ecculiomphalus* sp., *Maclurites* sp., и т. д.

(2) Сарганский отдел ( $O_2^f$ )—в её верхней части представлены серозеленые песчанистые сланцы с узкой полосой бурсерых песчанистых известняков; в средней части—серозеленные кальциевые сланцы с узкой полосой бурсерых известняков; в нижней части—темнокрасные, кемковато-кусковые известняки и известковые сланцы, в этой толще были собраны всего 6 пластов с ископаемыми, такие как: головоногие: *Orthoceras suni* Yü, *O. squamatulum* Barrande, *O. regulare* Schlotheim, *Sinoceras rudum* Yü, *S. chinense* (Foord), *Michelinoceras* spp., *Palaeocycloceras wangi* Yü, *Discoceras* sp., *Lituities* sp., *Faleroceras* sp., *Pseudorthoceras* sp., *Polygrammoceras* sp.; граптолиты: *Climacograptus*, *Glyptograptus*, трилобиты: *Basiliella* sp. и т. д.

Вышеупомянутые две стратиграфических единицы ордовика носят название, назначенное экспедицией № 13, но размер ограничен, Синицын назначил отложения среднего ордовика серией Су-Баши, так как к которой Норин уже отнес пермские отложения в области Куру-Таге. Для того, чтобы избавиться от беспорядка, это название следует аннулировать.

## 3. Силурская система.

Разрез силурских отложений измерен в устье оврага Су-Баши.

Вышележащие отложения—серия Шараймь (девона).

——согласный контакт——

Силу-кельпинтакский отдел ( $S^t$ )

-----параллельное несогласие-----

Нижнележащие отложения—Сарганская серия O<sub>1</sub>

В основании Кэлпинтакской серии представлена мощностью примерно 2 м конгломератная толща. В средней и верхней частях—серо-зеленные песчаники с прослоями сланцев. На поверхности отложений видны ясные волнистые отпечатки, в районе Кэлпинтак в изветнях с телами двояковыпуклой линзы развиваются коралловые ископаемые: *Propora* sp., *Codonophyllum* sp. и т. д. Стратиграфическая единица носит название, назначенно экспедицией № 13.

#### 4. Девонская система.

Девонские отложения в горах Кэлпина наиболее развиты в области Шараймь. 13-ая экспедиция Министерства геологии назвала их серией (D') Шараймь. Разрезы девонских отложений, обнажающиеся в устье оврага Су-Баши, выделяются на следующие:

Нижняя часть серии Тамайртак состоит из кирпично-красных и зеленоватых, тонкослоистых песчаников, алевролитов с кирпичными и фиолетово-красными глинами, она имеет мощность 130 м. Мы пользуемся названием серии Татайр-Так, назначенным экспедицией № 13 Министерства геологии, для представления этого переходящего от силура к девону участка осадных отложений.

Верхняя часть серии Шараймь состоит из кирпично-красных и светлокрасных, мелкозернистых песчаников и алевролитов, чередующиеся слоистости значительно развиты, общая мощность 850 м в нижней части её показывается согласный контакт с Кэлпинской свитой силура, в верхней части—псевдосогласный контакт с Конкринской серией карбона.

#### 5. Карбонская система.

Область Кэлпинтаге может расчлена на две структурных отдельности, Кэлпинские края и Муздукская зона (переходного типа) границы расчленения двух отдельности находятся в южной стороне Матан. В кэлпинских краях отсутствовали системы нижнего и среднего карбона; система верхнего карбона, обнажающаяся около Субаши полно развита.

Вышележащие отложения-отдел Балекли нижнего перми.

—согласие—

Отдел Конкрин верхнего карбона

78.63 м.

----псевдосогласие----

Нижнележащие отложения—Шараймская свита девона.

Отдел Конкрин наблюдается светлосерыми известняками, богато содержащими фузулиниды, среди которых были определены следующие: *Triticites mogtovensis* Rosovskaya, T. cf. *creekensis* Thompson, *Pseudoschwagerina* cf. *beedei* D. et S., *Paraschwagerina* aff. *gigantea* (White), *Schwagerina longa* Kireeva, *Schwagerina* sp.

Возраст отнесен к верхнему карбону, он соответствует известнякам Мапин южного Китая и свите Тайюань северного Китая.

Развитие карбонской свиты моздукской полосы полное. Около деревни Шафарпай западнее от уезда Уши Башисогунская свита нижнего карбона состоит из нижней толщи конгломератов и верхней толщи известняков. Мощность обнажения составляет 45 м. Верхняя часть имеет сбросный контакт с ордовиком; нижняя часть покрывается покровами, в известняках развиваются карбонские ископаемые: *Kueichowphyllum*, *Dibunophyllum*, *Arachnolasma* и другие; среднекарбонская свита

представлена комплексными сланцами с меньшинством известняков, составляет 140 м. В известняках экспедиция № 13 нашла элементы ископаемых фузулинид среднего карбона: *Fusulina nytvica* Saf., поэтому они назначены названием "свитой Сугаданом", отложения верхнего карбона полнее обнажаются в области Матан севернее от Кельпина, которые можно делить на две части—верхнюю и нижнюю, первая состоит из кусковых известняков тонкослоистых известняков, общая мощность составляет 254.5 м. в известняках имеются фуздилиды: *Triticites*, *Quasifusulina*, *Pseudoschwagerina*, мшанки: *Fenestella*, *Strebletrypa*, *Fistulipora* cf. *sinensis* Yoh и т. д. Возраст следует относить к верхнему карбону.

#### 6. Пермская система.

Стратиграфический разрез перми тоже измерился в двух местах: Су-Баши и Матан. Нижняя часть имеет согласный контакт с конкринским отделом, верхняя часть—угловое несогласие с триасовыми отложениями.

Примером можно служить разрез Су-Баши:

Вышепокрывающие отложения-триас.

~~~~~несогласие~~~~~

Верхний пермь—Калэндарский отдел ( $P_2^1$ ) примерно 800 м.

Нижний пермь—Балеклекский отдел ( $P_1^1$ ) 210.68 м.

——согласие——

Нижнележащие отложения—отдел Конкрин верхнего карбона.

(2) Балеклекский отдел ( $P_1^1$ )—нижняя часть состоит из мощностью 20 м. красных железоносных песчаников, верхняя часть—темносерых известняков, богато содержащих плеченогие и мшанки, среди которых были определены следующие, а именно, Плеченогие: *Dictyoclostus*, *Dielasma*, *Echinoconchus*, *Canarinella*, *Marginifera*, *Notothuris*, *Phricodorhyris*; Мшанки: *Fistulipora*, *Stroblascopora*, *Meekocera*, *Fenestella*, *Rhynchdomeson* и т. д.

(1) Характер пород отдела Калэндар в основании состоит из желтых тонкослоистых песчаников и глин, в его основании пород содержатся обломки пресноводных ископаемых гастропод, пластичотомидов и растений.

Вышеуказанные двух стратиграфические единицы носят название, назначенное Нориним.

#### Область западного Куэнь-Лунь-Шань

Здесь указанная область западного Куэнь-лунь-шань является областью, где экспедиция № 13 работала в 1957 году. Географическая координата находится между  $36^{\circ}55'$ — $38^{\circ}00'$ -ым градусом северной широты и  $76^{\circ}15'$ — $78^{\circ}00'$ -ым градусом восточной долготы. Она соответствует изгибистой полосе западного Куэнь-лунь-шань, здесь раньше было названо Шачэху; на этот раз, мы только в деревнях Калан-Уй и Пуджо западней от Ципан в уезде Ежэн провели разработку разреза пермской свиты.

В нижнекарбонской свите только появляются солитовые известняки, верхняя и нижняя части её покрываются покровыми. В других местах экспедиция № 13 наблюдала нижнекарбонскую свиту, характер пород её представлен известняками, доломитами и кварцитами; нижняя часть проявляет несогласный контакт с песчанистыми конгломератами, среднекарбонская свита представлена приморскими отло-

жениями, состоящими из песчаников, известковых сланцев и известняков, мощность составляет 200 м среди которых развиваются фузулины: *Pseudostaffella*, *Fusiella*, *Ozawainella*, *Fusulinella*, *Fusulina*; Кораллиты: *Caninia*, *Dibunophyllum*, *Lophophyllidium* и т. д., а верхнекарбонская свита является сплошными известняками, — мощность составляет 111—220 м в ней развиваются ископаемые фузулины: *Triticites*, *Quasifusulina*, *Pseudoschwagerina* и других. Нижнепермская свита полностью представлена переслаиванием песчаных сланцев и известняков; в последних развиваются ископаемые плеченогие: *Cancrinella*, *Dictyoclostus*, *Buxtonia*, *Marginifera*? и другие, мощность 120 м; верхнепермская свита полностью состоит из песчаных сланцев, в которых не видно известковых отложений, мощность составляет 200 м.

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# 华北及东北崮山統三叶虫动物羣

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(附 7 图版)

## 引 言

崮山頁岩之名为維理士(Willis)和白維德(Blackwelder)創于1907年,系指中寒武紀張夏灰岩以上的頁岩,其时代确定为中寒武紀的晚期。崮山頁岩的动物羣,先后經皮正龙(Bergeron)、华可脫(Walcott, C. D.)、小林貞一(Kobayashi, T.)、远藤隆次(Endo, R.)、雷士(Resser, C. E.)等人的研究均認為是中寒武紀的晚期,但另外如孟克(Monke, H.)、瑞德(Reed, F. R. C.)和孙云鑄教授等人則認為屬上寒武紀之早期。孙云鑄教授曾于1937年在“崮山統的时代問題”一文中首先將山东泰安汶河地区的崮山頁岩重新划分为两部:下部为汶水层,包含两个化石带,上为 *Demesella blackwelderi* 带,下为 *Amphoton typica* 带,其时代为中寒武紀之晚期;上部为崮山层,亦有两个化石带,上为 *Drepanura premesnili* 带,下为 *Blackwelderia sinensis* 带,其时代为上寒武紀之早期。之后,孙云鑄教授又于1948年在“关于中国寒武紀地层界綫問題”一文中,从动物羣关系和沉积間断上論述了崮山統应为上寒武紀。随之1950年太子河队在調查辽宁太子河流域地层时,对该地区之寒武紀地层做了詳細的剖面 and 系統的采集了化石,为解决崮山統的时代問題提供了更充足的依据,如在本溪營子之北的駱駝岭子剖面中見到張夏統和崮山統之間有一个假整合存在,崮山統基底砾岩沉积在張夏統鲕状石灰岩低凹之处。1952年卢衍豪和董南庭两先生在“山东寒武紀标准剖面新观察”一文中,也同意將崮山統放置于上寒武系之底部,同时还补充了三点意見,即:第一、崮山統前沉积問題;第二、岩层划分問題;第三、生物羣的关系問題。此次笔者在研究了辽宁太子河流域、山东、山西、內蒙等地区的崮山統化石后,認為崮山統应为上寒武系之底部。

本文研究的崮山統三叶虫标本系来自东北及华北五个地点:(1)为王鈺、卢衍豪、楊敬之、穆恩之、盛金章諸先生及太子河队全体人員采自辽宁太子河流域本溪、辽阳等地,(2)为卢衍豪、董南庭两先生采自山东崮山,(3)为盛金章先生等采自江苏北部賈汪煤田,(4)为盛金章先生等采自山西隰县石口鎮云梦山,(5)为賈福海、高存礼两先生采自內蒙清水河县。笔者謹对上述諸先生致以衷心的謝意。

本文是在卢衍豪教授的直接指导和鼓励下完成的,卢教授并抽暇詳尽的审阅了原稿,对本文进行了重大的修正;孙云鑄教授給予宝贵的指示,斯行健教授詳尽的修改了英文原稿,作者謹向他們致以衷心的謝意。此外图版照象为庞茂芳同志代劳,邹曼庆和邹志学同志在工作中常予协助,也一併附此致謝。



## 地 层 略 述

兹将重要的以及有关的地层剖面及化石层位分别简述于后：

## (一) 辽宁太子河区

1. 田师付东三里腰堡剖面：这个剖面在腰堡东北面，铁路旁边。其层序如下：

上覆地层：长山统(白山层)

(2) 紫红色竹叶状石灰岩夹黄色页岩(大部掩盖) 8米

(1) 红紫色页岩及黄色石灰岩，有时为鲕状 8米

中寒武纪张夏统：浅灰色结晶质石灰岩。

——断层——

上寒武纪崮山统：同(2)，内产3层化石。自上而下：

BE874: *Walcottaspidea suni* Chu (新属新种) *Blackwelderia paronai* (Airaghi)

BE875: *Drepanura premesnili* Bergeron, *Diceratocephalus armatus* Lu, *Pseudagnostus douvillei* (Bergeron), *Chiawangella pacifica* (Walcott), *Blackwelderia sinensis* (Bergeron)。

BE876: *Blackwelderia paronai* (Airaghi), *Homagnostus (Quadragnostus) subquadratus* Chu (新亚属、新种)、*Homagnostus (Quadragnostus) tienshihfuensis* Chu (新亚属、新种)、*Blackwelderia sinensis* (Bergeron)、*Lorenzella subcylindrica* Chu (新种)、*Pseudagnostus douvillei* (Bergeron)、*Kushanopyge serrata* Chu (新属、新种)、*Blackwelderia mui* Chu (新种)、*Blackwelderia cf. octaspina* (Kobayashi)。

2. 本溪营子北二道沟剖面：二道沟位于火莲寨车站之东约6里，营子北约2里。此处崮山统地层以假整合关系复于张夏统之上，但崮山统与长山统之间，则无明显界限可寻。自上而下：

上覆地层：长山统(白山层)

(4) 紫色及黄色石灰质页岩，下部夹石灰岩层。自上而下产：

BE121: *Pseudagnostus* sp. (保存不好)、*Homagnostus taitzeensis* Chu (新种)、*Drepanura premesnili* Bergeron, *Diceratocephalus armatus* Lu, *Diceratocephalus latifrons* Lu, *Taitzeoia wangi* Chu (新属、新种)、*T. erhtaokouensis* Chu (新属、新种)、*Liostracina krausei* Monke, *Blackwelderia sinensis* (Bergeron)、*Paramenomonina conica* Chu (新属、新种)、*Wutingshanina lui* Chu (新属、新种)、*Teinistion* sp. (保存太坏)、*Blackwelderia paronai* (Airaghi)、*B. shengi* Chu (新种)。

BE122: *Blackwelderia sinensis* (Bergeron)、*B. shengi* Chu (新种)、*Diceratocephalus armatus* Lu。

BE123: *Blackwelderia sinensis* (Bergeron)、*B. paronai* (Airaghi)、*Blackwelderiodes monkei* (Walcott)、*Lorenzella* sp. (保存不好)、*Liostracina krausei* Monke, *Stephanocare richthofeni* Monke, *Drepanura premesnili* Bergeron, *Blackwelderia liaoningensis* Chu (新种)。

BE124: *Blackwelderia paronai* (Airaghi) 6.4米

(3) 灰色成层脆性石灰岩，夹数层鲕状石灰岩及竹叶状石灰岩互层。 4.3米

(2) 暗紫色石灰质页岩。 6.4米

(1) 鲕状石灰岩及砂质石灰岩，上部暗紫色，中部夹薄层石灰岩及白云质石灰岩，下部为紫色页岩，在其底部有细砾岩一层复于张夏统不平的侵蚀面上。中部含化石两层：

BE125: *Lorenzella parabola* Lu, *Blackwelderia sinensis* (Bergeron)。

BE126: *Lorenzella parabola* Lu, *Blackwelderia sinensis* (Bergeron), *Homagnostus convexus* Chu (新种)、*Lotagnostus* (?) sp., *Teinistion yangi* Chu (新种)。

7米

下伏地层:张夏统

3. 本溪营子北駱駝岭子剖面:此剖面在上述二道沟剖面之东北,距二道沟约5—6里。自上而下:

上覆地层:长山统(白山层)

(3) 大部分掩盖,朱古力色,紫灰色頁岩,可能包括一部分白山统。20米

(2) 黄灰、灰色結核状石灰岩与紫灰色石灰质頁岩互层,上部为蓝灰色薄层白云质石灰岩夹綠灰色頁岩。自上而下产:

BE385: *Liaoningaspis taitzeoensis* Chu (新属、新种)、*Blackwelderia paronai* (Airaghi)、*Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新亚属、新种)。

BE386: *Lorenzella parabola* Lu、*Pseudagnostus douvillei* (Bergeron)、*Blackwelderia sinensis* (Bergeron)。

BE387: *Blackwelderia paronai* (Airaghi)、*Lorenzella parabola* Lu、*Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新亚属、新种)、*Blackwelderia paronai* var. *penchiensis* Chu (新变种)。

10米

(1) 基底砾岩层,砾石为各种不同石灰岩組成,作不規則形或楔形,基質为紫紅色鉄质物,有时成鲕状。0.6米

下伏地层:张夏统

4. 辽阳烟台当十岭剖面:当十岭剖面位于辽宁辽阳烟台煤矿东南约12里。自上而下:

上覆地层:长山统(白山层)

(4) 黄色及綠色頁岩,产:

BE439, BE452: *Pseudagnostus douvillei* (Bergeron)、*Drepanura premesnili* Bergeron、*Diceratocephalus armatus* Lu、*Liostracina krausei* Monke。

13.7米

(3) 灰色薄层石灰岩,部分具鲕状結構。产:

BE449: *Drepanura premesnili* Bergeron、*D. ketteleri* Monke、*Stephanocare richthofeni* Monke、*Lorenzella pustulosa* Chu (新种)、*Liostracina krausei* Monke、*Blackwelderia paronai* (Airaghi)。

5.1米

(2) 黄灰色結核状石灰岩及凸鏡状石灰岩,产:

BE448: *Blackwelderia paronai* (Airaghi)、*Liaoningaspis taitzeoensis* Chu (新属、新种)、*Blackwelderia paronai* var. *penchiensis* Chu (新变种)、*Lorenzella parabola* Lu。

6米

(1) 暗紫色及灰色頁岩,产:

BE438: *Stephanocare richthofeni* Monke、*Homagnostus taitzeoensis* Chu (新种)、*Teinistion tangshihlingensis* Chu (新种)、*Teinistion yangi* Chu (新种)、*Tangshihlingia subtriangulata* Chu (新属、新种)。

5.1米

下伏地层:张夏统

5. 辽阳烟台五頂山剖面:此剖面在烟台煤矿之南约10里。自上而下:

(4) 黄色及綠色頁岩,产:

BE409, BE410: *Pseudagnostus douvillei* (Bergeron)、*Drepanura premesnili* Bergeron、*Diceratocephalus armatus* Lu、*D. latifrons* Lu、*Blackwelderia sinensis* (Bergeron)、*Liostracina krausei* Monke、*Paramenomonina conica* Chu (新属、新种)、*Wutingshanian lui* Chu (新属、新种)、*Taitzeoia wangi* Chu (新属、新种)、*T. erhtaokouensis* Chu (新属、新种)、*Homagnostus taitzeoensis* Chu (新种)、*Teinistion yangi* Chu (新种)、*Shantungia* (*parashantungia*) *elongata* Chu (新亚属、新种)。

10米

## (4) 棕黃色及綠黃色頁岩,产:

BE414: *Pseudagnostus douvillei* (Bergeron)、*Blackwelderia sinensis* (Bergeron)、*B. paronai* (Airaghi)、*B. (?) sp.*、*Drepanura premesnili* Bergeron、*Liostracina krausei* Monke。 2.6 米

## (3) 黃色及灰黃色鈣質頁岩,偶夾石灰質結核,产:

BE413: *Pseudagnostus douvillei* (Bergeron)、*Liostracina krausei* Monke、*Drepanura ketteleri* Monke、*Blackwelderia sinensis* (Bergeron)。 3.5 米

## (2) 黃色及灰黃色結核狀石灰岩及黃色鈣質頁岩。 4.7 米

## (1) 淺灰色薄層石灰岩,含不能鑑定的三叶虫碎片,底部未露出。 7 米

## (二) 山东崗山東北唐王寨剖面

上覆地層:長山統

## (3) 淡灰、橘黃色及綠色頁岩夾石灰質結核。产:

BW37: *Drepanura premesnili* Bergeron、*D. ketteleri* Monke、*Blackwelderia sinensis* (Bergeron)、*Shantungia spinifera* Walcott、*Metashantungia brevicla* Chang、*Pseudagnostus douvillei* (Bergeron)、*Liostracina krausei* Monke。 4 米

## (2) 藍灰色板狀石灰岩。 8 米

## (1) 綠色頁岩夾少量紫色頁岩及一二層竹葉狀石灰質礫岩與石灰岩鏡體。石灰岩鏡體中产:

BW36: *Blackwelderia sinensis* (Bergeron)、*Lorenzella kushanensis* Chu (新种)、*Agnostids*。 15 米

下伏地層:張夏統

## (三) 苏北賈汪

## 1. 賈汪西南約 15 里龐家洼村至花廟村剖面。自上而下:

上覆地層:長山統

## (6) 灰色薄層灰岩(層面具黃色泥質一層及蠕虫狀物突露岩表)夾少數蠕狀灰岩及礫狀灰岩。

Ls67: *Damesellinae* 三叶虫(尾部邊緣一塊) 22 米

## (5) 灰色厚層細粒蠕狀灰岩與灰岩互層,并夾薄層灰岩與竹葉狀灰岩。在中部产:

Ls51: *Lorenzella parabola* Lu 23 米

## (4) 灰色厚層半結晶灰岩夾長條狀竹葉狀灰岩,产:

Ls50: *Blackwelderia paronai* (Airaghi)、*Lorenzella parabola* Lu 2 米

## (3) 灰色結晶灰岩夾綠色小點,产:

Ls7: *Blackwelderia paronai* (Airaghi)、*Drepanura (?) sp.*

Ls49: *Damesops convexus* Chu (新属、新种)。 0.5 米

## (2) 紫色、綠色堅硬灰岩,产:

Ls31: *Blackwelderia sp.* (保存太坏) 0.7 米

## (1) 薄層灰岩夾泥質灰岩。 3.8 米

下伏地層:張夏統

## 2. 王可樂西采石場剖面:自上而下:

上覆地層:長山統

## (3) 灰色薄層石灰岩,層面上具黃色泥質物一層。 20.5 米

## (2) 灰色中層堅硬蠕狀灰岩與灰岩互層,底部灰岩中具綠色小點,岩性略帶紫色。距頂部 5 米,采

得:

Ls56: *Stephanocare richthofeni* Monke, *Liostracina krausei* Monke, *Chiawangella pustulosa* Chu (新属、新种)、*Drepanura transversa* Chu (新种)。

29 米

(1) 薄层灰色灰岩

3 米

3. 賈汪大黄山南坡(王可乐之南 2—3 里)剖面:自上而下:

上覆地层:长山統

(3) 灰色薄层灰岩,层面上具黄色泥质物一薄层,有时具长条蠕虫状物,突出岩表,产:

Ls25: *Drepanura premesnili* Bergeron

20.1 米

(2) 厚层灰岩,紫棕色,具绿色小点,风化面褐色,与鲕状灰岩互层。

Ls58: *Homagnostus convexus* (?) Chu (新种) (保存不好)、*Blackwelderia* sp. (保存的太坏)、*Liostracina krausei* Monke。

Ls59: *Damesellinae* 三叶虫

26 米

(1) 薄层灰色灰岩

4 米

#### (四) 山西隰县石口鎮云梦山剖面

上覆地层:板状泥质灰岩夹竹叶状灰岩。

该地区崾山統地层为薄层泥质板状灰岩,层面具泥质物及蠕虫状条带夹灰岩及鲕状灰岩少許及椭圆砾状灰岩,自上而下产:

Sk18a: *Chuangioides punctatus* Chu (新属、新种)

Sk18b: *Chuangioides punctatus* Chu (新属、新种)、*Blackwelderia paronai* (Airaghi)、

*Dorypygella hsihsienensis* Chu (新种)、种属未定的 *Saukid*。头盖

Sk19: *Chuangioides punctatus* Chu (新属、新种)、*Liaoningaspis* (?) sp.

31.7 米

下伏地层:灰色粗粒鲕状灰岩。

基于以上各地区剖面有关材料的研究,崾山統的两个化石带是非常明显的,即:

上带: *Drepanura premesnili* 带

下带: *Blackwelderia paronai* 带

在东北太子河流域 *Drepanura premesnili* 带中 *Diceratocephalus* 一属常居于上部,曾由卢衍豪教授单独分出成为一亚带。

另外和崾山統可以对比的地层在朝鲜南部和云南与越南交界的地方亦有发现。在朝鲜南部小林貞一在細松統内建立了两个化石带,即:

上带: *Drepanura* 带

下带: *Stephanocare* 带

据目前所知 *Stephanocare* 一属不仅在 *Drepanura* 带有大量的出现,而且在下带 *Blackwelderia* 带亦有少量出现。又据小林貞一的报告, *Stephanocare* 带除产 *Stephanocare richthofeni* Monke 外,还有 *Pseudagnostus douvillei* (Bergeron),但此种化石亦为上下两带所具有。所以朝鲜南部細松統的 *Stephanocare* 带是否与我們的 *Blackwelderia paronai* 带相当或許仅相当于 *Drepanura premesnili* 带的一部不易确定。在滇越交界相当于崾山統的动物羣,最初为滿苏氏(H. Mansuy)所研究,1944 年小林貞一研究了滿苏氏的报告后,将此建立了三个化石带,自上而下为: *Damesella brevicauda* 带, *Drepanura premesnili* 带, *Annamilia spinifera* 带,但因该地区地层尚未搞清,化石层位,上下关系尚不明确,暫难与华北、东北地区相对比。

崑山統动物羣和北美及欧洲的关系至今还不能完全明确,其本身的区域性非常显著,很少与其他各地区动物羣相混合。除欧洲发现有 *Drepanura* 外,一般情况,崑山統动物羣与北美区上寒武紀动物羣较为接近,例如新属 *Paramenomonina* 与北美 *Cedaria* 带所产的 *Menomonina* 在形态上很相似,又新属 *Liaoningaspis* 与北美上寒武紀出現的 *Dikelocephalidae* 科三叶虫亦很相近。

### 各种、属在两化石帶的分布

本文研究材料系来自东北太子河流域及华北山东崑山、山西隰县、苏北賈汪及内蒙清水河等地。共得 22 属及 1 亚属 (9 个新属, 1 个新亚属), 48 种及 1 变种 (28 个新种及 1 新变种), 即:

上带 (*Drepanura premesnili* 带): *Drepanura premesnili* Bergeron, *D. ketteleri* Monke, *Blackwelderia paronai* (Airaghi), *B. sinensis* (Bergeron), *Stephanocare richthofeni* Monke, *Pseudagnostus douvillei* (Bergeron), *Shantungia spinifera* Walcott, *Blackwelderioides monkei* (Walcott), *Blackwelderia* cf. *octaspina* (Kobayashi), *Diceratocephalus armatus* Lu, *D. latifrons* Lu, *Ordosia fimbriacauda* Lu, *Metashantungia brevicata* Chang, *Chiawangella pacifica* (Walcott), *Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新亚属, 新种), *Homagnostus* (*Quadrahomagnostus*) *tienshihfuensis* Chu (新亚属, 新种), *Lorenzella pustulosa* Chu (新种), *Lorenzella subcylindrica* Chu (新种), *Lorenzella* (?) *convexa* Endo et Resser, *Teinistion yangi* Chu (新种), *Taitzehoia wangi* Chu (新属, 新种), *T. erhtaokouensis* Chu (新属, 新种), *Blackwelderia mui* Chu (新种), *B. liaoningensis* Chu (新种), *B. shengi* Chu (新种), *B.* (?) sp., *Blackwelderia chiawangensis* Chu (新种), *Drepanura transversa* Chu (新种), *Wutingshanian lui* Chu (新属, 新种), *Shantungia* (*Parashantungia*) *elongata* Chu (新亚属, 新种), *Paramenomonina conica* Chu (新属, 新种), *Walcottaspidella suni* Chu (新属, 新种), *Chiawangella pustulosa* Chu (新属, 新种), *Homagnostus taitzehoensis* Chu (新种)。

下带 (*Blackwelderia paronai* 带): *Blackwelderia paronai* (Airaghi), *B. sinensis* (Bergeron), *Pseudagnostus douvillei* (Bergeron), *Lorenzella parabola* Lu, *L. yentaiensis* Chu (新种), *L. kushanensis* Chu (新种), *Homagnostus taitzehoensis* Chu (新种), *H. convexus* Chu (新种), *Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新亚属, 新种), *Liaoningaspis taitzehoensis* Chu (新属, 新种), *Damesops convexus* Chu (新属, 新种), *Tangshihlingia subtriangulata* Chu (新属, 新种), *Blackwelderia paronai* var. *penchiensis* Chu (新变种), *Lotagnostus* (?) sp., *Stephanocare richthofeni* Monke, *Teinistion yangi* Chu (新种), *T. tangshihlingensis* Chu (新种), *T. liaoningensis* Chu (新种)。

另外 *Chuangioides punctatus* Chu (新属, 新种), *Dorypygella hsihsienensis* Chu (新种) 的层位不清楚, 难于确定属于何带。

茲将这些三叶虫依照在两化石帶的分布情况列表如下:



### 續上表

[illegible]

## 二、山东崮山(盧衍豪,董南庭先生采集)

|                                                                  | Blackwelderia paronai 带 | Drepanura premesnili 带 |
|------------------------------------------------------------------|-------------------------|------------------------|
|                                                                  | BW 36                   | BW 37                  |
| Agnostidae 科                                                     |                         |                        |
| <i>Pseudagnostus douvillei</i> (Bergeron)                        |                         | ×                      |
| Damesellidae 科                                                   |                         |                        |
| <i>Blackwelderia sinensis</i> (Bergeron)                         | ×                       |                        |
| <i>Drepanura premesnili</i> Bergeron                             |                         | ×                      |
| <i>Drepanura ketteleri</i> Monke                                 |                         | ×                      |
| <i>Shantungia</i> ( <i>Metashantungia</i> ) <i>brevica</i> Chang |                         | ×                      |
| <i>Shantungia spinifera</i> Walcott                              |                         | ×                      |
| Liostracinidae 科                                                 |                         |                        |
| <i>Liostracina krausei</i> Monke                                 |                         | ×                      |
| Utidae 科                                                         |                         |                        |
| <i>Lorenzella kushanensis</i> Chu (新种)                           | ×                       |                        |

## 三、苏北賈汪(盛金章先生采集)

|                                            | Blackwelderia paronai 带 |    |    |    | Drepanura premesnili 带 |    |    |
|--------------------------------------------|-------------------------|----|----|----|------------------------|----|----|
|                                            | LS 7                    | 49 | 50 | 51 | LS 25                  | 56 | 58 |
| Agnostidae 科                               |                         |    |    |    |                        |    |    |
| <i>Homagnostus convexus</i> (?) Chu (新种)   |                         |    |    |    |                        |    | ×  |
| Damesellidae 科                             |                         |    |    |    |                        |    |    |
| <i>Blackwelderia paronai</i> (Airaghi)     | ×                       |    | ×  |    |                        |    |    |
| <i>Damesops convexus</i> Chu (新属, 新种)      |                         | ×  |    |    |                        |    |    |
| <i>Drepanura premesnili</i> Bergeron       |                         |    |    |    | ×                      | ×  |    |
| <i>Drepanura transversa</i> Chu (新种)       |                         |    |    |    |                        | ×  |    |
| <i>Stephanocare richthofeni</i> Monke      |                         |    |    |    |                        | ×  |    |
| <i>Chiawangella pustulosa</i> Chu (新属, 新种) |                         |    |    |    |                        | ×  |    |
| Liostracinidae 科                           |                         |    |    |    |                        |    |    |
| <i>Liostracina krausei</i> Monke           |                         |    |    |    |                        | ×  | ×  |
| Utidae 科                                   |                         |    |    |    |                        |    |    |
| <i>Lorenzella parabola</i> Lu              |                         |    | ×  | ×  |                        |    |    |
| Saukiidae 科                                |                         |    |    |    |                        |    |    |
| 种属未定的 Saukid. 2.                           |                         |    |    |    |                        |    |    |

## 四、山西隰县石口镇云梦山(盛金章先生采集)

产有 *Blackwelderia paronai* (Airaghi), [SK18], *Lorenzella parabola* Lu, [SK18], *Dorypygella hsihsienensis* Chu (新种) [SK18], 种属未定的 Saukid. 头盖 [SK18], *Chuangioides punctatus* Chu (新属, 新种) [SK18a, SK18, SK19], *Liaoningaspis* (?) sp. [SK19]。其化石层位尚未搞清难于确定属于何带。

## 五、内蒙清水河县(賈福海、高存礼先生采集)

产有 *Drepanura premesnili* Bergeron, *Blackwelderia paronai* (Airaghi), *Ordosia fimbriata* Lu, *Blackwelderia sinensis* (Bergeron), *Liostracina krausei* Monke, *Stephanocare richthofeni* Monke, *Myonia flabelliformis* Kobayashi, 均产于 *Drepanura premesnili* 带。



## 种 属 描 述

超科 Agnostacea Salter, 1864

科 Agnostidae (Corda, 1847) Salter, 1864

亚科 Agnostinae Jaekel, 1909

属 *Homagnostus* Howell, 1935属型 *Agnostus pisiformis obesus* (Belt), 1867*Homagnostus convexus* Chu (新种)

(图版 I, 图 1—7)

**描述:** 头部突出。边缘宽而略凸起, 边缘沟深。头鞍锥形, 略高出于颊部, 前端圆钝或平缓尖出。头鞍前叶小, 约为头鞍长的三分之一, 与后叶为一浅而窄以及略微向后弯曲或近于直的横沟所分。中疣出现, 但在标本内没有保存。基底叶非常小, 近似三角形。颊部光滑, 在头鞍前为一明显的中沟所分, 并向着边缘强烈下倾。

尾部近似圆形, 强烈突出。在轴部前缘几乎平直, 其两侧向后倾斜。中轴非常宽而长, 高出于肋叶以上, 约占尾部前部宽度的三分之二, 并向后伸延至后边缘, 为两对横沟分为三个叶节。第一对沟短而不连续; 第二对颇长, 相遇于中部, 略微向后侧部倾斜。第一轴叶很短, 大约为轴叶长的八分之一; 第二叶长, 具有一突出的中疣。后部第三叶很大, 在中部强烈扩大, 后端圆钝。背沟极明显, 前部近似平行, 后部从第二轴叶后侧角向后分枝伸出, 最后又向内弯曲并和边缘沟融合。边缘略宽, 凸起, 具有一对短的边缘刺。边缘沟深而宽。肋叶很窄, 其两侧强烈向下倾斜。

另外还有两个小的尾部的一个小头部标本。其头部近似圆形, 突出; 头鞍作锥形, 前端很尖; 头鞍前中沟清楚; 头鞍前叶小, 近似圆形; 横沟浅; 背沟清楚; 边缘较狭。其尾部中轴相当凸起, 并伸延至边缘, 中轴后叶略扩大; 背沟近似平行, 后部和边缘沟融合; 中疣凸起; 边缘宽, 边缘沟窄。此两个小尾部和 *H. taitzehoensis* 的相当的阶段相比较, 其尾部中轴宽、长、而凸起, 背沟后部和后边缘沟融合, 由此可见种的区别。

**比较:** 此新种看上去非常相近于 *Pseudagnostus*, 尤其是尾部, 因其具有非常大的轴叶和背沟的后部在两侧强烈的倾斜, 这个特点很难和 *Pseudagnostus* 的次生附加沟相区别, 但是 *Pseudagnostus* 的次生附加沟是很短而直的, 相交于尾部的两侧边缘。而 *Homagnostus convexus* 的背沟从第二轴叶两后侧角向外伸出, 并向两侧倾斜伸延, 然后又向内向后弯曲, 在轴叶后部和边缘融合。

*H. convexus* 和美国 Montana 中部 *Cedaria* 带和 *Crepicephalus* 带所产之 *H. lochmene* Howell et Duncan 非常相似, 但此新种具有明显的头鞍前中沟和较宽的头部边缘; 其尾部特征是尾部中轴较大, 中轴第三叶节较长, 尾部边缘较窄和边缘沟较深而宽。

层位和产地: *Blackwelderia paronai* 带; 辽宁本溪营子二道沟 (BE 126)。

*Homagnostus taitzehoensis* Chu (新种)

(图版 I, 图 8—19)

**描述:** 标本是保存在页岩中, 被压平。

头部近似半圆形,宽度和长度约相等。边缘窄,宽度略相等,凸起;边缘沟浅向后部逐渐变窄。头鞍锥形,前端尖,但不成尖角,其宽度为头部宽的三分之一。头鞍前叶小,以一浅而略向后弯曲的横沟与后叶分开;后叶上具有一对非常不清楚的侧沟和一微弱的中疣,其位置约距前叶三分之一处。基底叶中等大小,作三角形。头鞍前中沟非常微弱;背沟清晰。

尾部近似半圆形,宽度和长度约相等。边缘窄,宽度略相等,凸起,具有一对非常短而小的边缘刺,边缘沟浅。中轴宽,约为尾部宽的三分之二,长,但不伸至边缘沟,为两对很不清楚的侧沟分成为三个轴叶。第一和第二轴叶的长度相等,在第二轴叶上具有一长的凸起的中疣,第三轴叶大,中部扩展,其后端或多或少是圆钝的。侧叶窄,在轴叶后互相融合。

表面光滑。

图版 I, 图 11—19 为一系列幼虫标本,代表了各发育阶段。

图版 I, 图 11 是一个最小的头部标本。头部近似方形,较长,长约 0.46 毫米,宽 0.40 毫米,头鞍锥形,前端成一尖角,头鞍前中沟清晰,头鞍前叶很小,近似三角形,大约为头鞍长的五分之一,边缘窄,边缘沟清楚,中疣微弱。图版 I, 图 12, 其头部头鞍作锥形,前端略尖,头鞍前中沟尚清晰,头鞍前叶较大,边缘窄,其他特点和上阶段相似;其长约 0.55 毫米,宽 0.5 毫米。图版 I, 图 13 为一较大的头部,长宽近似相等(0.80 毫米),头鞍作锥形,前端略尖,但不成尖角,头鞍前叶的长度小于头鞍长的三分之一,头鞍前中沟浅,微弱,边缘很窄。图版 I 图 14 已为成虫阶段,和图 16 的不同仅是个体较小。图版 I, 图 15 是一个最小的尾部,近似方形,其长约 0.6 毫米,宽 0.55 毫米,中轴作长三角形,后端很尖,前部各节因保存不好而不清楚。图版 I 图 16 的尾部,长约 0.75 毫米,宽约 0.70 毫米,中轴作锥形,后端圆钝,在前部具有两个横沟,和在第二叶节上有一个中疣,边缘沟清楚,边缘宽,并具有一对小的边缘刺。图版 I 图 17 为较大的尾部,其长宽近似相等(1.0 毫米),中轴近似柱形,中部略收缩,后端圆钝,其他特点基本上和前阶段相似。图版 I 图 18 为更大的尾部,其长约 1.60 毫米,宽 1.80 毫米。具有近似半圆状的外形,它和前一阶段主要不同为略略扩大的中轴后叶,较狭的边缘及较宽而平的肋叶。图版 I 图 19 已为成虫阶段,和图 9、10 主要不同为略扩大的中轴后叶。

上述幼虫期至成虫期各器官发育主要过程可简单归纳如下:

1. 头部和尾部在幼虫期外形均较长,近似方形,在生长过程中继续扩大其宽度至成虫期则发育成近似半圆形。

2. 头部的中沟在幼虫期是清楚的,到成虫期则不清楚。

3. 头部的头鞍在幼虫期前端很尖,成为尖角到成虫期则略尖亦不成尖角。

4. 头部的头鞍前叶在幼虫期很小,近似三角形至成虫期则成半圆形,并具有一弯曲的横沟。

5. 尾部的中轴在幼虫期近似三角形,后端很尖,以后中轴逐渐扩大成为锥形、柱形,到成虫期其轴叶中部扩大,形成半球状。

6. 尾部的边缘在幼虫期很宽,后逐渐变窄。

比较: *H. taitzehoensis* 的头部和中国北部长山统所产的 *H. hoi* (Sun) 不同之处是中疣位于后叶上,横沟略微向后弯曲,中沟微弱和基底叶中等大小,其尾部不同是具有比

較寬大的中軸和不清楚的橫溝。

由幼虫发育的各阶段中可以看出 *Homagnostus* 和 *Pseudagnostus* 有同一来源而后分支发展。早在 1937 年小林貞一就曾指出“一个趋向是头鞍前叶的扩展如 *Pleuroctenium* 和 *Paragnostus*。另一趋向是尾部后轴叶的扩展,在此趋向中又有两个发展方向可以区别,一个是尾部后轴叶自己扩展,另一个是发育了附加次生沟所限制的假叶节,但真正的后叶是在假叶的里面而不扩展。”后 1939 年他又认为“*Pseudagnostus* 可能来源于中寒武纪而相似于 *Doryagnostus incertus*”,笔者将 *H. taitzehoensis* 和 Palmer 1953 年描述的 *Pseudagnostus communis* (Hall et Whitfield) 的幼虫做一比较,可以看到其最小的标本(目前所找到的最小的标本)均具有锥形的(近似三角形的)分节的尾部中轴和具有宽的尾部边缘;不管 *Pseudagnostus* 尾部中轴后叶是否为真叶节或假叶节,均可以说明 *Homagnostus* 和 *Pseudagnostus* 是来源于中寒武纪具有锥形而分节的尾部中轴的 agnostid 而后分枝发展来的,这点小林貞一可能是正确的。

层位和产地: *Blackwelderia paronai* 带; 辽宁辽阳烟台当十岭 (BE 438); *Drepanura premesnili* 带, 辽宁本溪营子二道沟 (BE 121) 和辽宁辽阳烟台五顶山 (BE 410)。

### 亚属 *Quadrahomagnostus* Chu (新亚属)

#### 亚属型 *Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新种)

特征: 头部近似方形, 向后收缩。边缘窄。横沟向后弯曲。头鞍前叶很小, 后叶上具有一对非常微弱的侧沟和一个向前弯曲的沟。中疣小。基底叶中等大小, 三角形。头鞍前中沟明显。背沟清楚。

尾部近似方形, 向前收缩。边缘窄, 其后侧部变宽, 具有一对短而强壮的边缘刺。轴叶大, 后叶成半球状。

比较: 何韦耳 (Howell) 以 *Agnostus pisiformis obesus* (Belt) 一类球节子三叶虫建立此属。其定义为“在头部具有发育的横沟和背沟, 光滑的表面, 具有两叶和前部略尖而不成尖角的头鞍, 微弱的中沟, 在尾部具有大的中轴, 后叶或多或少成半球状”。*Q.* 和 *H.* 一样, 具有发育的背沟和横沟, 光滑的表面, 前部略尖但不成尖角的头鞍, 大的、半球形的尾轴; 但此新亚属和 *H.* 主要不同为近似方形的头部和尾部, 小的头鞍前叶和特殊的头鞍沟。

层位和产地: 上寒武纪下部崑山统; 辽宁太子河流域。

#### *Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (新种)

(图版 I, 图 21—24)

描述: 头部近似方形, 向后收缩, 略微凸起; 边缘窄, 凸起, 宽度近似相等; 边缘沟宽, 向后逐渐变浅和变窄。头鞍近似锥形, 前端略尖, 但不成尖角, 头鞍前叶很小, 近似圆形, 与后叶为一狭而强烈向后弯曲的横沟所分; 在后叶上, 距前叶约三分之一处有一对非常微弱的侧沟, 同时在后叶的中部有一个连接的而又弯曲的沟, 此沟中部不易察见。中疣小,

位于头鞍后叶之中部。基底叶中等大小,三角形。头鞍前中沟清楚,直接与头鞍和前边缘相接。背沟清晰。

胸部不明。

尾部近似方形,向前收缩;边缘沟宽而清楚;边缘窄,后侧部变宽,凸起;具有一对短而强壮的边缘刺。轴叶宽而长,大约为尾部宽度的三分之二,高出肋叶之上,并向后延伸近于边缘沟,以两对横沟分成为三个叶节。前一对沟仅在边部较深,向内逐渐变浅,并在中部略略向前延伸。第一叶和第二叶近似相等,较宽,在第二叶上具有一个长的中疣,中疣前端向前平缓倾斜,后端突然向后倾下;第三叶或后叶大,后端圆钝,其上并具有一纵脊。在很好保存的标本上(图版 I, 图 23),在纵脊的两侧排列有四个突出的小点形成椭圆形,此外在第一对小点前并具有一对大的筋痕。肋叶凸起,向着边缘下倾。

表面光滑。

比较:在图版 I 图 23 的尾部中轴第三叶节上出现了由突出的小点组成的一个椭圆形,这个特征曾在 *Pseudagnostus* 一属中出现过。小林贞一曾认为 *Pseudagnostus* 的尾部中轴第三叶节是一假叶节,其限制叶节的沟为次生的斜沟而不是背沟,同时他认为真叶节在假叶节之内,为出现的椭圆形的坑所代表,亦指出这些小坑为筋肉连接的印痕,但目前,在 *Homagnostus* 内亦有发现,其不同仅是 *Homagnostus* 为突起的小点所组成的椭圆形,如果认为这些特征均为筋肉痕的话,其小点和小坑并无什么区别,筋肉痕可以是小坑也可以是小点;因此笔者想到至少说这些小坑或小点代表 *Pseudagnostus* 的中轴第三叶节(真叶节)是不正确的。或者更可怀疑 *Pseudagnostus* 的中轴第三叶节是否为假叶节,或许象是屈德森 (Troedsson) 所指出的它是前部叶节的伸延和扩展。巴尔玛 (Palmer 1954) 在北美德克萨斯 (Texas) 中部 *Aphelaspis* 带中找到 *Pseudagnostus communis* (Hall et Whitfield) 在尾部中轴第三叶节上,也出现了这样的小坑,在这篇文章中巴尔玛认为屈德森是对的,并指出这些小坑仅为筋肉痕。但在 1956 年他在 Nevada 找到 *Pseudagnostus communis* (Hall et Whitfield) 的个体发育的标本,根据标本的研究,Palmer 认为小林贞一的假叶节说法是正确的,但笔者认为巴尔玛的标本对作个体演化的研究来讲未免是少些,因此 *Pseudagnostus* 中轴第三叶节是否为真或假叶节尚可怀疑,并且有待于新材料的发现和研究。

层位和产地: *Blackwelderia paronai* 带;辽宁省田师付腰堡 (BE 876), *Drepanura premesnili* 带,辽宁省烟台五顶山 (BE 410);辽宁省本溪营子二道沟 (BE 385, BE 387)。

### *Homagnostus* (*Quadragnostus*) *tienshihuensis* Chu (新种)

(图版 I, 图 25—26)

比较:此种与亚属型 *Q. subquadratus* 主要不同之点是具有较大的头鞍前叶,头鞍上并有一较少向后弯曲的横沟和比较宽而短的尾部中轴后叶。在 *H. subquadratus* 尾部中轴后叶上出现的椭圆形的突起点在此种内尚未见到,但一对大的筋肉痕仍然发生在后叶的前部。

层位和产地: *Blackwelderia paronai* 带;辽宁省田师付腰堡 (BE 876)。

屬 *Lotagnostus* Whitehouse, 1936  
 屬型 *Agnostus trisectus* Salter, 1864  
*Lotagnostus* (?) sp.  
 (图版 I, 图 20)

我們的标本是一个近似圓形的,凸起的小头部,有一寬的边緣和深而窄的边緣沟。头鞍突出,其長約为头部長度的四分之三,寬为三分之一,向前收縮,前端渾圓;在头鞍后叶上距前叶三分之一处有一对浅的側沟,仅在边部可以察見,恰在側沟之下有一个小的中疣。基底叶小,三角形。頰部飾有非常微弱的放射的細沟,并为—清楚的头鞍前中沟所分。

此标本非常相似于 *Lotagnostus* Whitehouse, 但它以小的头鞍前叶,小的基底叶和寬的边緣与 *Lotagnostus* 区别;另外我們的标本仅为一块保存不甚完美的头部,显然对属名和种名的确定是困难的,現暫以簡单的描述記錄出来,尙待更好和更多的标本的發現。

层位和产地: *Blackwelderia paronai* 带;辽宁本溪营子二道沟(BE 126)。

种 屬 未 定 者 a

(图版 I, 图 27)

尾部近似方形,向后側部变寬,边緣凸起,具有一对非常小的边緣刺。軸叶突出,长,不伸达至边緣沟,前部近似柱形,后部突然收縮,末端尖,分节不清楚,隱約見有三个叶节。第一和第二叶节短,近似相等,第二叶节上具有一个突出的中疣。

此尾部和 *Doryagnostus Kobayashi* 有某些相似之点,但是它与后者之不同是具有近似四方形的輪廓,寬的边緣和位于軸叶中部的中疣,再者此尾部的后軸叶亦不凹陷。

层位和产地: *Blackwelderia paronai* 带;辽宁省、烟台当十岭(BE 451)。

种 屬 未 定 者 b

(图版 I, 图 28—29)

几个压平了的尾部保存在頁岩中,一般的說此类尾部和 *Peronopsis* 很相似,在于大約相同的外形和均具有边緣刺,但不同之点是此类尾部具有較窄的和更成錐形的軸叶以及較长的中軸后叶。

层位和产地: *Drepanura premesnili* 带,辽宁省烟台五頂山(BE 410)和辽宁省本溪营子二道沟(BE 121)。

超科 *Agrauloidae* Hupé, 1953

科 *Agraulidae* Raymond, 1913

屬 *Tangshihlingia* Chu (新屬)

屬型 *Tangshihlingia subtriangulata* Chu (新种)

特征: 小型三叶虫,具有低的凸度,头盖近似三角形,头鞍作短截錐形,沒有头鞍沟,背沟在兩側深而清晰,在头鞍前端仅隱約可見。边緣平或微微凸起,向前伸出,在前端

或多或少呈角度相交,其长度较短于头鞍。頸环宽度相等。固定頰中等宽度;眼叶中等大小,位于头盖的后部。面綫前支从眼叶伸出,向前收缩延伸,切前緣成一圓潤的曲綫;后支非常短,从眼叶向外向后伸出。

*Tangshihlingia* 归入到 *Agraulidae* 科之内。它和 *Agraulos* Corda 非常相似,在于均有宽度相等的頸环和同样类型的边缘,但其不同之处为此新属具有截錐形的头鞍,近似三角形的边缘,中等大小的眼叶和低的凸度。*Metagraulos* Kobayashi 和新属略相似,但 *Metagraulos* 具有很凸出的头鞍和中间宽或突出成刺的頸环。北美上寒武纪产的 *Bynumia* Walcott 亦和 *Tangshihlingia* 相似,在于三角形的头盖,截錐形头鞍,但 *Bynumia* 和我们新属是容易区别的,借于位于头盖中部的眼叶和在头鞍前頗微弱的背沟。

层位和产地: *Blackwelderia paronai* 带;辽宁省太子河流域。

### *Tangshihlingia subtriangulata* Chu (新种)

(图版 I, 图 33—34)

描述: 头盖近似三角形,小,一般长度不超过 1.5 毫米,宽度不超过 2.0 毫米;头鞍作截錐形,中等凸度,向前变平,与边缘的界限不清楚,没有头鞍沟;背沟在后部宽而深,向前变浅,至头鞍前则非常微弱。边缘平,前端成角度相交。頸沟横直,清楚,頸环略凸起,中间较宽,略向两侧变狭。眼叶中等大小,位于头鞍中綫之后,无眼脊;固定頰略凸起,其宽度大约为头鞍底部宽的三分之二。后边缘狭,后边缘沟深而狭;面綫前支由眼叶伸出,向前收缩,切前緣微成一曲綫;后支短,从眼叶后端略向外和向后伸出。

表面光滑。

胸部和尾部不明。

层位和产地: *Blackwelderia paronai* 带,辽宁辽阳烟台当十岭(BE 438, BE 451)。

### 超科 *Utioidea* Hupé, 1953

### 科 *Liostracinidae* Raymond, 1937

### 属 *Liostracina* Monke, 1903

### 属型 *Liostracina krausei* Monke, 1903

### *Liostracina krausei* Monke

(图版 I, 图 30—32)

1903 *Liostracina krausei* Monke, Obercambrische trilobiten von Yen-Tzy-Yai, p. 114, Pl. 3, Figs. 10—17.

1905 *Ptychoparia ceus* Walcott, Proc. U. S. Nat. Mus. Vol. 29, p. 76.

1913 *Liostracina krausei* Walcott, Research in China, Vol. 3, p. 143, Pl. 11, Fig. 8, Pl. 14, Figs 2, 2a.

1935 *Liostracina krausei* Kobayashi, Journ. Fac. Sci. Imp. Uni. Tokyo, Sect. 2, Vol. 4, part 2, p. 254,

Pl. 12, fig. 6, Pl. 13, fig. 9.

1937 *Liostracina krausei* Endo et Resser, Manchurian Sci. Mus. Bull. 1, p. 233, Pl. 51, Figs. 11, 12.

*Liostracina krausei* 为孟克于 1903 年所创,孟克和华克脱对此种都曾作过详细的描述,因此笔者不再重复;但孟克于 1903 年所描述的两个尾部由图上观察是保存不甚完好的,而我们此次在苏北賈汪所得之尾部保存甚完美,所以笔者将其尾部详细描述并将头部

特点指出。

此种头盖的主要特征为头盖小,具有锥形的但前端圆的头鞍,略微凸起的内边缘,并具有一纵沟,此纵沟从头鞍前向着边缘沟伸出,外边缘略翘起,具有一对小的但凸起的边叶,位于头鞍的两后侧角。

尾部短,较宽,具有窄而凸起的边缘;后边缘沟窄而深;轴叶逐渐向后收缩,末端浑圆,向后伸延几乎到达后边缘,为窄而清楚的轴沟分为4—5个轴节及一个末叶;肋叶宽,近似三角形,具有4—5对非常窄的肋沟;前缘直,两侧尖出。

表面光滑。

层位及产地: *Drepanura premesnili* 带;江苏北部贾汪;山东崮山;辽宁省辽阳烟台当十岭和五顶山。

### 科 Utiadae Kobayashi, 1935

#### 属 *Lorenzella* Kobayashi, 1935

#### 属型 *Agraulos abaris* Walcott

#### *Lorenzella parabola* Lu

(图版 I, 图 35, 图版 II, 图 1—5)

1957 *Lorenzella parabola* Lu, 中国标准化石三叶虫部分, 272 页, 图版 I, 图 14。

描述: 头部作半圆形, 突出; 背沟非常深、宽; 头鞍由左至右强烈凸起, 由前至后略凸起, 截锥形, 具有三对倾斜的头鞍沟, 前面的一对非常短, 仅在头鞍两侧边缘上作有印痕, 第二对较深而宽, 第三对颇长, 由背沟向内并略向后倾斜。边缘特别凸起, 较宽, 在头鞍前形成锥形结构, 并具有一对从头鞍前侧角向前伸出的斜沟, 此斜沟伸达至前缘。颈沟清楚, 几乎是直的或在中部略微向前拱出; 颈环作半圆形, 中部宽, 向两侧变窄, 强烈凸起, 具有一小中疣。眼叶中等大小, 位于头鞍相对之中部; 眼脊明显, 从背沟相对第一对头鞍沟处向外几乎平行伸出, 然后逐渐向后并向外弯曲与眼叶接触。固定颊强烈凸起, 其宽度约为头鞍底部宽的三分之二, 向着背沟几乎是直的倾斜。后边缘沟浅而宽, 后部是直的, 两侧向前弯曲, 后边缘在中部较宽。活动颊小, 几乎是平的, 前部窄, 侧边缘中等宽度, 沿边缘排列有 8 个小突起; 颊刺很短, 向侧部并略向后伸出。面线前支从眼叶前端向外伸出, 然后向前向内弯曲, 切前侧边缘成一圆钝的曲线; 后支短, 略向后伸出, 几乎是横的, 切后侧边缘于颊刺之后。

尾部作纺锤形, 其宽度大约为长度的二倍; 轴叶凸起, 作锥形, 向后收缩, 并伸延至边缘, 微弱的分为 5—6 节; 肋叶近似三角形, 凸起, 具有一对深的肋沟(第一对)和四对线状的凸起的脊线; 边缘窄而凸起, 边缘沟清楚。

表面光滑。

比较: 此种非常相似于 *L. (?) ogrurai* Endo et Resser 其不同为此种头鞍沟清晰, 内边缘和固定颊特别凸起。另外 *L. quadrata* Kobayashi 和此种的区分主要是近似方形的头盖, 没有沟的头鞍, 边缘上没有小突起点的活动颊, 半卵形的尾部, 短的尾轴, 向内弯曲的后缘和不具有边缘。

目前归入于 *Lorenzella* 属内的尾部, 有两种不同的类型, 一是尾部边缘没有边缘刺如

*L. parabola* 和从朝鲜南部 Shoku-do 和 Kasetsu-ji *Drepanura* 带所产的 *L. quadrata* Kobayashi 内所見到的, 另外是尾部带有边缘刺, 如从辽宁东部双庙子中寒武系太子层所产的 *L. rotundata* Endo et Resser 内所見到的; 因为至今尚未找到完整的 *Lorenzella* 的个体, 所以归入于 *Lorenzella* 属内的这两种类型的尾部都是可疑的。

在所有的材料当中, *L. parabola* 主要产于江苏北部賈汪和辽宁太子河流域, 但以太子河流域本溪营子二道沟剖面 (BE 126) 中最多, 与其共生的仅有少量的 *Pseudagnostus*, *Blackwelderia*, 和 *Teinistion*。

层位和产地: *Blackwelderia paronai* 带; 辽宁省本溪营子二道沟 (BE 125, BE 126), 江苏北部賈汪 (Ls 50, Ls 51, Ls 55)。

### *Lorenzella pustulosa* Chu (新种)

(图版 II, 图 6—8)

描述: 头盖小, 半卵形; 头鞍强烈突出, 高出于颊部之上, 作截锥形, 具有一对非常微弱而倾斜的头鞍沟; 背沟非常清晰; 边缘凸起, 为一对倾斜的沟分为三叶, 此对沟自头鞍前侧角向着前缘伸出; 颈环中部宽, 颈沟直; 无眼脊; 固定颊具有和边缘相同的凸度, 其宽度略狭于头鞍的宽度; 面线向前收缩。

表面具有较大的疣点。

比较: 此种和 *L. (?) convexa* Endo et Resser 的区别为小的头盖, 较少凸起的内边缘和固定颊和在表面出现有较大的疣点。

层位和产地: *Drepanura premesnili* 带; 辽宁省辽阳烟台当十岭 (BE 449)。

### *Lorenzella subcylindrica* Chu (新种)

(图版 II, 图 11—13)

描述: 头鞍凸起, 近似柱形或非常轻微的向前收缩; 具有三对短、非常微弱而倾斜的头鞍沟; 背沟深而宽; 边缘凸起, 在头鞍前成一低凸度的隆起, 并向前拱出形成一宽的、不尖的角度; 颈环半圆形, 中部具有一个中疣; 眼叶中等大小, 位于后部; 眼脊明显; 固定颊中等凸度, 窄, 其宽度大约为头鞍底部宽的二分之一。

尾部近似纺锤形; 轴部凸起, 作锥形, 向后收缩, 后端圆钝, 并伸至后边缘, 微弱的分为 5—6 节; 肋叶上具有一对深的肋沟 (第一对) 和四对线状的凸起的脊线; 边缘窄而凸起, 边缘沟不清楚。

比较: 此种和澳大利亚南部 Curramulka 的中寒武系 (Parara 灰岩) 中所产的 *L. tatei* (Woodward) 相似, 在于两者均具有窄而不成尖角的边缘, 但此种以窄的固定颊, 深而宽的背沟和出现一对从头鞍前侧角伸出横过边缘的斜沟与 *L. tatei* (Woodward) 相区别。

层位和产地: *Blackwelderia paronai* 带; 辽宁省田师付东腰堡 (BE 876)。

### *Lorenzella yentaiensis* Chu (新种)

(图版 II, 图 9—10)

比较: 此种和同层位所产的 *L. parabola* 有某些相似, 但其不同之处为较少凸起的边



緣和固定頰,較小的个体,較长的头鞍和較寬的固定頰。

层位和产地: *Blackwelderia paronai* 带;辽宁省辽阳烟台当十岭 (BE 451)。

### *Lorenzella kushanensis* Chu (新种)

(图版 II, 图 14—15)

比較: 此新种和 *L. parabola* Lu 非常相似, 但它以較长的头鞍, 較少凸起的边緣和固定頰和非常明显的眼脊与后者相区别。

层位和产地: *Blackwelderia paronai* 带; 山东省崗山唐王寨 (BW 36)。

### *Lorenzella* (?) *convexa* Endo et Resser

(图版 II, 图 16)

1937 *Lorenzella* (?) *convexa* Endo et Resser, Manchurian Sci. Mus. Bull. 1, p. 233, Pl. 55, Figs. 18—19; Pl. 65, Figs. 26—27.

我們手中的标本和远藤的标本是非常相似的如具有相同的头盖輪廓, 凸起的边緣和表面上具有小疣点。但是我們的标本是被保存在頁岩中, 因而被压平, 所以标本的凸度要比远藤的被保存在灰岩中的标本的凸度为低。

层位和产地: *Drepanura premesnili* 带; 辽宁省辽阳烟台五頂山 (BE 409)。

### 超科 Olenoidae Hupé, 1953

#### 科 Damesellidae Kobayashi, 1935

#### 亚科 Dorypygellinae Kobayashi, 1941

#### 屬 *Teinistion* Monke, 1903

#### 屬型 *Teinistion lansi* Monke, 1903

#### *Teinistion yangi* Chu (新种)

(图版 II, 图 17—23)

描述: 头鞍凸起, 截錐形, 前端近于直綫。具有两对不連接的头鞍沟: 后一对长, 強烈向后傾斜; 前一对极微弱, 仅在头鞍两边隱約可見。内边緣很窄, 凹下; 外边緣两侧窄, 其中部寬, 向内对着边緣沟傾斜, 边緣沟向着头盖前側角傾斜伸延; 前緣在中部略微向后弯曲。頸沟直而明显, 頸环寬度均匀。眼叶中等大小, 位于头盖的后部; 眼脊強壯, 由头鞍前側角向着眼叶向外向后延伸。固定頰略微凸起, 其寬度大約和头鞍底部相等, 并在头鞍两后側角处具有一对大的半圓形的边叶。后翼窄, 近似长三角形; 后边緣窄, 寬度一致, 后边緣沟深; 面綫前支由眼叶前端伸出, 向前略分开, 然后又向内伸延, 切前緣成強烈的弯曲, 后支強烈向外伸展几乎和后边緣平行, 然后突然向后翻轉切于后緣, 其从背沟开始至此的距离等于头鞍底部寬度的两倍。活动頰近似三角形, 略凸起; 側边緣前部窄, 向后变寬并伸出一长而大的頰刺。

尾部近似半圓形, 其寬度大約为长度的两倍; 中軸作錐形, 窄, 逐漸向后收縮, 以一窄的脊与后边緣相連接, 略高出肋叶之上, 具有六个軸节, 横沟清楚, 肋叶近似三角形, 平, 具有 5—6 对寬而凹下的肋沟和微弱的間肋沟; 边緣清晰; 具有六对边緣刺, 其中以第一对

最长大,由第一个肋节直接倾斜伸出。

表面光滑。

比较:此新种非常相似于属型 *T. lansi* Monke, 但此新种以截锥形的头鞍,略向后弯曲的前缘和在背沟两侧出现一对半圆形的边叶与属型相区别。

另外,与 *T. yangi* 相似的是 *T. truncatus* Endo, 但后者以较宽的边缘和固定颊上缺失边叶与前者区别。

此种标本多保存在页岩中,仅三个头盖保存在灰岩中(BE 126),灰岩中标本除了保持有相当凸度外,仅以边缘沟向前侧角倾斜伸延比页岩中的标本较斜,为其不同之点。笔者认为此点不同,不具有鉴定为新种的特点,仅为个体变化或保存关系所致。

层位和产地: *Blackwelderia paronai* 带; 从1. 辽宁省辽阳烟台当十岭 (BE 451, BE 438); 2. 辽宁省本溪营子二道沟 (BE 126); *Drepanura premesnili* 带, 辽宁省辽阳烟台五顶山 (BE 410)。

### *Teinistion tangshihlingensis* Chu (新种)

(图版 II, 图 24—25)

此种仅为两个保存不甚好的头盖所代表。

描述: 头鞍宽,截锥形,中等凸度;头鞍沟不清楚。外边缘在中部略向后拱出,向两侧变窄,略翘起;前缘几乎成一直线。眼脊微弱,眼叶位于头盖的后部;固定颊比较窄,具有一对小的半圆形的边叶。

比较: 此种与 *T. yangi* 不同之处为具有宽的头鞍,较宽的外边缘,直的前缘和比较窄的固定颊。

层位和产地: *Blackwelderia paronai* 带; 辽宁省辽阳烟台当十岭 (BE 451, BE 438)。

### *Teinistion liaoningensis* Chu (新种)

(图版 II, 图 26—27)

虽然此种仅有两个保存不甚好的头盖,但它的特征是显著的,能鉴定为一新种。

比较: 此种与 *T. yangi* 的区别为近似柱形的头鞍和非常宽的固定颊。它与 *T. tangshihlingensis* 不同之处为宽的固定颊和在中部向后弯曲的前缘。

层位和产地: *Blackwelderia paronai* 带; 辽宁省辽阳烟台当十岭 (BE 451)。

### 属 *Dorypygella* Walcott, 1905

#### 属型 *Dorypygella typicalis* Walcott, 1905

#### *Dorypygella hsihsienensis* Chu (新种)

(图版 II, 图 28; 图版 III, 图 1)

描述: 头鞍凸起,作长锥形,前端浑圆;头鞍沟缺失。边缘狭而翘起,边缘沟深,前缘直。颈沟浅,中部略向后弯曲;颈环宽度均匀。眼脊非常明显,倾斜;固定颊中等宽度,大约为头鞍底部宽度的三分之二,从背沟向着眼叶方向凸起,而又下斜靠近背沟有一对小的卵形的边叶。面线前支不明,后支从眼叶后端向外又略向后倾斜延伸,然后又向后弯曲,切

于后邊緣，其从背沟至此之距离等于头鞍底部寬度的一倍半。

表面光滑。

比較：此新种与 *Dorypygella typicalis* Walcott 非常相似，其不同之点为比較窄的固定頰，較寬的后邊緣，和缺失头鞍沟。它和 *D. alcon* Walcott 不同之处为較大的头鞍，不具头鞍沟，較寬的固定頰和非常明显的眼脊。

层位和产地：崑山統；山西隰县 (SK18)。

### 屬 *Drepanura* Bergeron, 1899

#### 屬型 *Drepanura premesnili* Bergeron, 1899

#### *Drepanura transversa* Chu (新种)

(图版 III, 图 2—3)

描述：尾部除邊緣刺外作寬半橢圓形，寬度約为长度的两倍；中軸近似柱形，具有一圓潤的末端，凸起，高出于肋叶之上，分成为三至四軸节及一个末叶，并附加一关节半环；肋叶近似三角形；前部为三对深的肋沟所分，肋沟直接向外及略向后伸延，尖灭于邊緣之內，后部完整无沟；第一个肋节大，向后伸出一对分歧的、略凸出的、短的、鑷刀形的側刺；在此側刺之間有六对短的刺，其中以外边第四对較长；表面具有少量的疣点。

比較：此种以較少傾斜的肋沟和寬的尾部外形为其特征。它和 *D. premesnili* Bergeron 不同之处为較长而近似柱形的軸叶和較长而尖的第一对側刺間的邊緣刺；与 *D. ketteleri* Monke 的区别为較窄而強烈分歧的第一对側刺。此种与瑞典 *Agnostus pisiformis* 带所产的 *D. eremita* Westergård 很相似，两者均具有近似柱形的和較长的中軸，比較清楚的邊緣和具有特別尖的邊緣刺。*D. transversa* 与瑞典种的区别，在于具有半圓形的輪廓，較少的軸节，寬的中軸和較长的邊緣刺。

层位和产地：*Drepanura premesnili* 带；江苏北部賈汪煤田 (Ls 56)。

### 屬 *Shantungia* Walcott, 1905

#### 亞屬 *Parashantungia* Chu (新亞屬)

#### 亞屬型 *Parashantungia elongata* Chu (新种)

此新亞屬与 *Shantungia* 很相似，但头鞍是長矩形，前邊緣是窄的和固定頰是比較窄的。其他一些特点見屬型的描述。

层位和产地：*Drepanura premesnili* 带；辽宁太子河流域。

#### *Parashantungia elongata* Chu (新种)

(图版 III, 图 4—5)

描述：头鞍大，長矩形，除前头刺外其长度約等于头盖長的三分之二，由左至右凸起，其前部向前傾斜；无头鞍沟；前邊緣窄，略凸起，前部成角度相交，并在中部向前延長成为一个細而圓的头刺；前邊緣沟在兩側深，向中部变浅并略向后拱出；內邊緣很窄与向下傾斜的头鞍前端分界不明显；頸环略凸起，寬度均匀；頸沟直，兩側深，中部浅；背沟在头鞍兩側深，在前部仅隱約可見；固定頰寬度較窄于头鞍的寬度，凸起，由背沟向着眼叶強烈突

出并略向上斜;眼叶大,弓形,位于头鞍中綫之后;眼脊微弱。后翼近似横三角形,从背沟向外伸延大約和头鞍寬度相等;面綫前支向前略收縮,切前緣成一圓角,后支傾斜延伸。

比較:雷士(Resser)和远藤隆次(Endo, 1937, Pl. 51, Fig. 15)所指出属于到 *Shantungia spinifera* 的一个头盖或許是属于此新种,但以截錐形的头鞍或許更相似于 *S. spinifera*。

层位和产地: *Drepanura premesnili* 带;辽宁省辽阳烟台五頂山(BE 410)。

### 亚属 *Metashantungia* Chang, 1957

#### 亚属型 *Shantungia brevica* Walcott, 1913

此属与 *Shantungia* 和 *Parashantungia* 均很相近,但 *Metashantungia* 的头盖較寬,也就是它的固定頰与头鞍是較寬的。它和 *Shantungia* 不同之点在于具有短的前边緣,短的头盖刺和面綫的形式。与 *Parashantungia* 不同之点在于具有截錐形的头鞍,短的头盖刺和面綫前支的形式。

地質和地理分布: *Drepanura premesnili* 带;山东。

### *Metashantungia brevica* Chang, 1957

(图版 III, 图 6—7)

1913 *Shantungia spinifera* Walcott, Research in China, Vol. 3, p. 148, Pl. 14, Fig. 6e.

1957 *Metashantungia brevica* Chang, Acta Palaeont. Sinica, Vol. 1, p. 31, Pl. 1, Fig. 6.

描述:头盖横寬,其寬度几乎为长度的二倍。头鞍凸起,截錐形,其长度略大于底部的寬度;无头鞍沟;背沟在兩側很深,在头鞍前部浅;外边緣窄,近似三角形,略凸起,在中部向前伸延出一短而小的刺,边緣沟直而深。頸沟浅而直;頸环在中部略向后拱出;固定頰凸起,其寬度大約为底部寬度之半,向着背沟強烈下斜;眼叶大,略高出于固定頰,位于头盖中綫之后;眼脊微弱。后边緣沟浅;后边緣窄而长,从背沟向外伸延,大于头鞍的寬度;面綫前支由眼叶伸出,略向外,后又強烈向內弯曲切于前緣;后支強烈向外,略向后伸展,切后边緣于頰角之內。

表面光滑。

层位和产地: *Drepanura premesnili* 带;山东省崑山唐王寨(BW 37)和山东省新泰南流泉(I 71)。

### 超科 Olenoidae Hupé, 1953

#### 科 Damesellidae Kobayashi, 1935

#### 亚科 Damesellinae Kobayashi, 1935

#### 属 *Taitzehoia* Chu (新属)

#### 属型 *Taitzehoia wangi* Chu (新种)

特征:头盖近似梯形。头鞍寬而长,伸至外边緣,截錐形,具有兩对傾斜的头鞍沟;背沟非常清晰;沒有內边緣,外边緣窄而平,前緣直;頸环寬度一致;固定頰窄,其寬度小于头

鞍的寬度；眼叶中等大小，位于头鞍相对之中部，眼脊微弱；面綫前支近于平行，后支傾斜伸延，活动頰具有非常短而又分为二枝的頰刺。

尾部作橫半圓形；中軸錐形，略凸起，为橫沟分为四个叶节和一个后端尖的末叶；肋叶具有5—6节；邊緣窄而明显，具有六对邊緣刺。

比較：此新属与 *Stephanocare* Monke 和 *Damesella* Walcott 均很相似，在于都沒有一个凹下的內邊緣；其不同之点在于此属具有光滑的表面和窄的固定頰。再者，*Stephanocare* 的头具有較大的眼叶和带刺的邊緣，其尾部沒有邊緣和邊緣刺是直接由每个肋节伸出。而 *Damesella* 是以寬的头，較寬、厚的外邊緣和具有末端圓潤的中軸的尾部为特征的。

*Taitzehoia* 大致亦可与 *Blackwelderia* Walcott 作一比較，但此新属具有寬的外邊緣，非常窄的固定頰，比較寬的头鞍和缺失內邊緣。

层位和产地：崑山統；*Drepanura premesnili* 带；辽宁太子河流域。

### *Taitzehoia wangi* Chu (新种)

(图版 III, 图 8—13)

描述：头鞍略凸起，作截錐形，較长，前端几乎成一直綫，但两前側角或多或少是圓潤的，伸至外邊緣；具有两对傾斜的头鞍沟：后一对长、深、由背沟向內、向后伸延，几乎与頸沟接触，前一对短但清楚；背沟非常明显；缺失內邊緣，外邊緣窄而略凸起，前緣直；頸沟圓潤，清楚，略向后弯曲；頸环微略凸起，寬度均匀，中部具有一个小疣；眼叶中等大小，位于头鞍相对之中部；眼脊短，微弱，由相对第一对头鞍沟向外水平伸出；固定頰略微凸起，窄，其寬度約为头鞍底部寬的三分之一。后邊緣清楚，邊緣沟深而寬，并向着頸环方向变窄；面綫前支由眼叶前端伸出，向前略分开，然后在距前緣很短的距离內突然向內翻轉，切前緣成一強烈傾斜的曲綫；后支自眼叶后端向外又略向后伸延，切于后邊緣，其从背沟至此之距离約等于头鞍底部的寬度；活动頰具有清楚的側邊緣及非常短的，分为二枝的頰刺。

尾部半圓形；中軸略凸起，錐形，伸至后邊緣沟，其寬度較小于尾部前端寬度的三分之一，逐渐向后变窄，为非常明显的橫沟分成5个节，末端尖；肋叶近似三角形，具有4—5对略傾斜的肋沟，間肋沟明显，与肋沟近似平行；邊緣窄但清楚；由邊緣伸出六对长的邊緣刺，其中以第六对最长。

表面光滑。

层位和产地：*Drepanura premesnili* 带；辽宁省本溪营子二道沟(BE 121)和辽宁省辽阳烟台五頂山(BE 410)。

### *Taitzehoia erhtaokouensis* Chu (新种)

(图版 III, 图 14)

比較：此种和属型 *T. wangi* 不同之点为較寬的头盖和較寬而短的头鞍。

层位和产地：*Drepanura premesnili* 带；辽宁省本溪营子二道沟(BE 121)和辽宁省辽阳烟台五頂山(BE 410)。

屬 *Blackwelderia* Walcott, 1906

屬型 *Calymene? sinensis* Bergeron, 1900

*Blackwelderia mui* Chu (新种)

(图版 III, 图 15)

描述: 头鞍凸起, 截錐形, 前端圓潤, 具有三对不連接的头鞍沟: 后一对非常显著, 深而长, 向內和向后傾斜; 第二对短, 不甚傾斜, 前一对微弱。背沟深而寬。內边緣寬而平, 略翹起; 外边緣很窄, 略凸起, 前緣向前拱出, 圓潤; 頸沟寬, 中部略向前拱出, 向兩側变窄和变深; 頸环寬度几乎一致, 中部具有一个小疣; 眼叶中等大小, 高举, 位于头鞍相对之中部; 眼脊不清楚, 略向后傾斜; 固定頰的寬度小于头鞍底部寬的二分之一, 由后向前凸起, 由背沟向眼叶方向突起, 而又下傾。后边緣沟深而寬; 后边緣窄, 向兩側略变寬。面綫前支近似平行, 切前緣成一圓潤的曲綫; 后支傾斜伸延。表面具有許多細小的疣点和散布了較大的疣点。

比較: 此种以圓潤的前緣和 *B. paronai* (Airaghi) 相似, 但是它以較窄的和較平的內边緣, 較寬和不甚凸起的头鞍, 具有小疣点和大疣点的壳面及近似平行的面綫前支与 *B. paronai* 相区别。

*B. mui* 亦和 *B. tieni* Sun 略略相似, 其不同之处为寬而平的边緣, 窄而略凸起的外边緣。再者此种的面綫前支切前緣成一圓潤的曲綫, 而 *B. tieni* 的面綫前支切前緣几乎成一直角。

层位和产地: *Blackwelderia paronai* 带; 辽宁省本溪田师付东腰堡 (BE 876)。

*Blackwelderia paronai* var. *penchiensis* Chu (新变种)

(图版 IV, 图 7—10)

此新变种与 *B. paronai* 不同之处为比較平的內边緣, 窄的略翹起的外边緣, 較直的前緣。再者此新变种面綫前支近似平行和尾軸較窄及后端較圓潤。

层位和产地: *Blackwelderia paronai* 带; 辽宁省辽阳烟台当十岭 (BE 448), 辽宁省本溪营子北駱駝岭子 (BE 387)。

*Blackwelderia liaoningensis* Chu (新种)

(图版 IV, 图 1)

描述: 头鞍凸起, 截錐形, 其长度大于头鞍底部的寬度, 具有三对头鞍沟: 前一对非常微弱, 第二对短, 深, 略向后向內傾斜, 后一对在从背沟伸出后的很短距离內分成为两支, 前一支頗短, 微弱, 水平; 后一支长, 強烈向后傾斜。內边緣寬而凹下, 外边緣窄而翹起, 前緣直。頸沟寬, 向后弯曲, 并向兩側变深; 頸环圓潤; 背沟很深, 寬; 眼脊缺失; 在頸环面上具有細小的疣点, 在头鞍和固定頰上具有大的疣点。

比較: 此新种以直的前緣, 頸环的式样和面綫的形式与 *B. sinensis* (Bergeron) 非常相似, 但此种以窄的固定頰和分为二枝的, 不橫过背沟进入固定頰形成反 V 字形的第三对 (后一对) 头鞍沟与 *B. sinensis* 相区别。

层位和产地：*Drepanura premesnili* 带；辽宁省本溪营子二道沟(BE 123)。

### *Blackwelderia shengi* Chu (新种)

(图版 IV, 图 2—6)

描述：头鞍凸起，作长截錐形，具有两对深的头鞍沟：后一对很长，强烈向后倾斜，几近于頸沟，前一对非常短；背沟頗浅，但清楚；内边緣略凹下，后部为三个半月形的弧綫所限制；外边緣中等凸度，前緣直；頸沟中部直，在两侧突然向前弯曲；頸环寬度均匀；眼叶中等大小，位于头盖之中綫；缺失眼脊；固定頰平，窄，其寬度小于头鞍底部寬的二分之一。后边緣沟寬而深；后翼近似三角形；面綫前支从眼叶前端伸出，彼此平行，此段长度約为前支长的三分之一，向前向内倾斜弯曲，切前緣成一鈍角；后支由眼叶后端直接向外向后倾斜伸延，切于后边緣，其从背沟的距离約等于头鞍底部的寬度。

尾部除边緣刺外呈三角形；中軸作錐形，后端圓潤，由五个軸节及一个末叶組成；肋叶上具有五个肋节；肋沟深而寬；間肋沟清晰；边緣非常狹，具有七对边緣刺，其橫剖面近似圓形。

头部和尾部表面上均具有許多大小不等的疣点。

比較：*B. shengi* 与 *B. sinensis* (Bergeron) 相关系，如均具有直的前緣，长截錐形的头鞍，具疣点的表面；但是 *B. shengi* 具有窄的固定頰，較短的后边緣，沿后边緣无大的疣点，尾部上有清楚的間肋沟和作三角形的外形。

此新种与 *B. liaoningensis* Chu (新种) 不同之点为具有較窄的内边緣和具有大小不同疣点的表面。

层位和产地：*Drepanura premesnili* 带；辽宁省本溪营子二道沟(BE 121, BE 122)。

### *Blackwelderia chiawangensis* Chu (新种)

(图版 V, 图 1)

描述：尾部除边緣刺外呈三角形。中軸凸起，近似錐形，由五个軸节及一个末叶組成；肋叶略凸起，为深而寬的肋沟分成六对肋节，肋节向后延續并縮小其体积。边緣窄而清楚，具有七对分歧的边緣刺，其中以第六对較长，較大，以第七对最短；第七对之間的后边緣直而寬，約为軸叶前部寬的三分之二。

表面具有疣点。

比較：此新种和 *B. spectabilis* Endo et Resser 非常相似，后者是小林貞一的新属 *Parablackwelderia* 的屬型；此种和后者不同之点为具有比較寬的軸叶，在末对刺之間具有較寬而較直的后边緣和帶疣点的表面。*B. chiawangensis* 与 *B. paronai* (Airaghi) 亦相似，但后者的肋叶較窄，并具有几乎直接向后伸出的边緣刺和光滑的表面。

层位和产地：*Drepanura premesnili* 带(?)；苏北賈汪煤田(Ls 68)。

### *Blackwelderia* cf. *octaspina* (Kobayashi)

(图版 IV, 图 13)

1937 *Blackwelderia octaspina* Endo et Resser, Manchurian Sci. Mus. Bull. 1, p. 188, Pl. 51, fig. 23.

此种仅为一个尾部标本。

我們的标本和小林貞一及远藤隆次的 *B. octaspina* 很相似, 如具有寬的半橢圓形的輪廓, 八对边緣刺, 其中以第一对最大和最长。在 1942 年小林貞一曾認為在許多特点上 *octaspina* 和 *monkei* 是彼此相似的, 其不同仅 *monkei* 具有七对边緣刺而 *octaspina* 具有八对边緣刺, 因此他考虑 *monkei* 为 *octaspina* 的幼虫的形式。但我們从辽宁省二道沟所找到的 *monkei* 的标本(图版 IV, 图 13)确实不象一个幼虫的形式, 它的长度有 12 毫米, 这个标本与孟克和华克脱所照象的 *monkei* 的标本很相似, 具有七对边緣刺。再者 *monkei* 在两端前側角上具有一对三角形的面, 同时 *octaspina* 的第一对边緣刺直接由边緣伸出而无三角形的前側面。因此筆者認為 *octaspina* 是一个独立的种, 而它和 *monkei* 是很相似的。

层位和产地: *Blackwelderia paronai* 带; 辽宁省本溪田师付东腰堡 (BE 876)。

### *Blackwelderia* (?) sp.

(图版 IV, 图 14)

一个保存不好的尾部, 近似三角形, 中軸錐形, 窄, 具有 6—7 个横沟和不清楚的边緣, 并带有七对几乎相等強壯的边緣刺。这个尾部和 *Blackwelderia* 最相近, 其不同仅仅是 *B.* 具有較清楚的边緣。它和 *Stephanocare* 不同之点为具有三角形的輪廓, 和較深而較寬的肋沟。因此这个尾部很可能是一个沒有描述的 *Blackwelderia* 的新种, 但是我們的标本是很少的, 而且保存亦不好, 所以不能給以新的名字。

层位和产地: *Drepanura premesnili* 带; 辽宁省辽阳烟台五頂山 (BE 414)。

### *Blackwelderia triangularis* Chu (新种)

(图版 IV, 图 11—12)

描述: 尾部除边緣刺外作三角形, 其长寬比例大約为 3:5; 軸叶比較窄, 长錐形, 強烈凸起, 具有 5—6 节及一个尖的末叶; 肋叶近似三角形, 中等凸度, 为肋沟分成 6—7 对頂部几乎平坦的肋节; 无間肋沟, 肋沟深, 比較窄, 尖灭于边緣; 肋沟向后突出成为七对平而长度大約相等的边緣刺。但是在較小的尾部上第七对刺是較短的(图版 IV 图 12)。边緣寬而平。

比較: 标本是从河南采集到的, 为三个尾部。与此新种最相似的是 *B. sinensis* (Bergeron), 但它以較窄的外形, 較窄的肋沟和較寬的边緣与后者相区别。另外它和 *B. shengi* Chu (新种) 亦相似, 具有三角形的尾部輪廓, 但后者有一較寬的軸叶, 非常寬而較少傾斜的肋沟和非常窄的边緣。

层位和产地: 崗山統; 河南中西部, 临汝县馬窩。



屬 *Blackwelderioides* Hupé, 1953屬型 *Stephanocare*? *monkei* Walcott, 1911*Blackwelderioides monkei* (Walcott)

(图版 V, 图 16)

1903 *Stephanocare* sp. Monke, Jahrb. Konigl. preuss. Geol. Landesanst. u. Bergakad. Bd. 23, Hft. 1, p. 144, Pl. 8, figs. 1, 1a, 2—4.

1911 *Stephanocare*? *monkei* Walcott, Smithsonian Misc. Coll. Vol. 57, No. 4, p. 77, Pl. 14, fig. 7.

1913 *Stephanocare*? *monkei* Walcott, Cambrian faunas of China, p. 113, Pl. 8, fig. 5.

1942 *Blackwelderia monkei* Kobayashi, Journ. Geol. Geogr., Vol. 18, No. 4, p. 208, Pl. 21, Fig. 3.

在我們所收集的标本中沒有找到此种的头。我們的 *B. monkei* 标本与孟克和华克脱的尾部标本很相似,具有半椭圆形的外形,宽度相等的肋节,两端前侧角具有三角形的面和具有七对边缘刺,其中以第一对刺是较长较大的。其不同之处是我們的标本长度为 12 毫米,而孟克和华克脱的标本长度仅 5—6 毫米。

层位和产地: *Drepanura premesnili* 带;辽宁省本溪营子二道沟(BE 123)。

屬 *Stephanocare* Monke, 1903屬型 *Stephanocare richthofeni* Monke, 1903*Stephanocare ordosensis* Chu (新种)

(图版 IV, 图 15—16)

描述: 尾部除边缘刺外近似半圆形;轴叶凸起,高出于肋叶之上,向后規則收缩,后端圓潤,为六个横沟分成五个轴节和一个小的末叶,并附加一关节半环,肋叶略凸起,在外部一半突然向下略傾斜,为肋沟分成六对肋节,每对肋节均由轴叶伸延;肋沟深而寬,直接向后伸延,間肋沟仅在肋节靠近轴部处微弱呈現;无边缘;具有七对边缘刺,其中以第七对較短而細长。表面光滑。

比較: 标本仅仅是两个尾部,因此此种的关系是不能肯定的。将此尾部鑑定为 *Stephanocare* 是因为它缺失边缘,出現有长的肋沟和一般所具有的外部輪廓。它和属型 *S. richthofeni* Monke 不同之点为表面上无疣点和具有七对长的边缘刺。华克脱(Walcott)从山东找到的 *Stephanocare*? sp. 尾部(Walcott, 1913, p. 116, Pl. 8, Fig. 6)具有七对边缘刺,但是它的轴叶是比較短的,前一对边缘刺是直接向后伸延的,而 *S. ordosensis* 是向外傾斜伸延。再者华克脱的尾部标本是很小的(約 3 毫米长),小林貞一(1941, p. 45)認為是 *S. richthofeni* 的年青时期。

层位和产地: 崑山統,內蒙清水河元子灣北沟 2 里。

屬 *Damesops* Chu (新屬)屬型 *Damesops convexus* Chu (新种)

特征: 头盖近似梯形,非常寬;头鞍凸起,作寬錐形,較寬,前端圓潤,并伸至边缘沟,具有三对傾斜的头鞍沟;背沟极明显;无內边缘,外边缘极狭,平;前緣直;頸沟寬,圓潤和

横直;頸环寬度均匀;固定頰強烈凸起,其寬度相等于眼叶間头鞍的寬;眼叶中等大小,位于头盖的中部。眼脊微弱;后翼近似三角形;后邊緣窄,后邊緣沟寬;表面具有小疣点。

比較:此新属在某些特点上是非常相似于 *Damesella* Walcott 但其不同点为具有寬的,作錐形的头鞍,非常窄而平的外邊緣和強烈凸起的固定頰。*Damesops* 亦和 *Blackwelderia* Walcott, 略相似,其不同在于此新属缺失凹陷的內邊緣,較寬的头盖和錐形的头鞍。

层位和产地: 崗山統 *Blackwelderia paronai* 带;江苏北部賈汪煤田 (Ls 49)。

### *Damesops convexus* Chu (新种)

(图版 V, 图 2—3)

描述: 头鞍凸起,錐形,迅速的向前收縮,前端圓潤,并強烈向下傾斜,其长度大約为底部寬度的五分之四。具有三对傾斜的头鞍沟: 后一对深而长,直接向內向后伸延,其距离大約占头鞍寬度的三分之一;第二对与第一对所伸延的方向相同,但比較短,前一对最短,几乎难以辨別,仅发现在头鞍两侧边上;頸沟寬,深而直;頸环凸起,中部寬度相等,向两侧变窄;外邊緣低,窄而平,前緣直;固定頰的寬度大約为头鞍底部寬的三分之二,由后至前強烈突起,向着背沟突然下斜;眼叶仅右侧部分保存,但由眼脊的后端和面綫后支形式来判断,眼叶是中等大小,位于头盖的中部;眼脊微弱,由背沟相对第一对头鞍沟处向外水平伸出;后邊緣沟深而寬,寬度均匀;后邊緣窄,略凸起,几乎等于頸环中部的长度。面綫前支已破坏;后支从眼叶向后傾斜伸延,成一 S 形弯曲。

头盖表面具有細小的和粗大的疣点。

尾部近似三角形,軸叶凸起,柱錐形,分成为 5—6 节及一个关节半环和一个圓潤的末叶;肋叶略凸起,为寬而浅的肋沟大約分成为 6 对肋节;間肋沟明显;具有七对邊緣刺,其中以第六对最长大,从第六肋节略向外傾斜伸出,第七对刺最短,平,作三角形。表面具有大的疣点。

比較: 此新种和 *Blackwelderia tschanghsingensis* Endo 略相似,后者曾被小林貞一考虑为 *B. sinensis* (Bergeron) 的变种(1942),但远藤隆次 (Endo) 的标本具有窄的,截錐形的头鞍和較寬的外邊緣,与此种相区别。暂时属于到此种的这个尾部很象产自山东大汶口的 *B. biloba* Kobayashi, 在于具有一对三角形的、平的后邊緣刺,但 *Damesops convexus* 的后邊緣刺之間的距离是較窄的和第二对邊緣刺是直接向外傾斜伸出。这个种是在苏北发现的,仅此一个种。

层位和产地: *Blackwelderia paronai* 带;江苏北部賈汪煤田 (Ls 49)。

### 亚科 Chiawangellinae Chu (新亚科)

特征: Damesellidae 科三叶虫,眼叶位于后部,眼脊清楚;尾部具有窄的肋叶和三对不同大小的邊緣刺。

### 屬 *Chiawangella* Chu (新屬)

#### 屬型 *Chiawangella pustulosa* Chu (新种)

特征：头鞍长，凸起，近似卵形，具有两对短而深的头鞍沟；背沟在两侧深，向前变浅；边缘窄，上翘；边缘沟宽，非常深，与背沟併合；頸沟清楚，頸环在中部略变宽，具有一中疣；固定颊的宽度约为眼叶间头鞍宽度的三分之二，向着背沟倾斜陡峻；眼叶中等长度，位于相对头鞍中綫之后；眼脊明显；面綫向前略收缩，切前边缘成一宽的曲线。

胸部不明。

尾部除边缘刺外作长卵形或近似梯形，向后收缩。中轴凸起，柱锥形，具有五个或更多个轴节；背沟清楚。肋叶窄，为两对宽的肋沟所分；前肋节末端形成一个细长的侧刺，第二个肋节颇大，向后侧部伸延成一个长而有力的侧刺；后边缘板平，具有一对细长的边缘刺。后缘直或圆润。

表面具小点或光滑。

地质和地理分布：*Drepanura premesnili* 带；华北和辽宁太子河流域。

比较：*Chiawangella* 除了属型之外，还有另外一个种，即华克脱 (Walcott) 所描述的 *Albertella pacifica*，它仅仅是一个保存不完整的尾部。因为此新属的头盖和 *Damesella* Walcott 是相近似的，所以将它归属于 *Damesellidae* 科之内。如果仅仅是尾部知道的话，很可能怀疑 *Chiawangella* 是与 *Albertellidae*，*Zacanthoididae* 是相关系的，尤其是和 *Albertella* Walcott，*Prozacanthoides* Resser 或 *Dolichometopidae* 科的 *Mexicaspis* Lochman。但是 *Chiawangella* 的头盖是非常不同的。在 *Damesellidae* 科内头盖的式样是变化的，由半圆形至宽的半椭圆形，头鞍是特殊的卵形，锥形或截锥形，眼叶是小的或中等的。在 *Albertellidae*，*Zacanthoididae* 和 *Dolichometopidae* 科内，头鞍是柱形，并且一般的向前扩展，眼叶经常是大的。

另外，*Chiawangella* 和 *Crephicephalidae* 科的三叶虫亦是很相近的，尤其是亚洲东部中寒武系所产的 *Crephicephalina* Resser et Endo 在于两者均具有位于后部的眼叶，长的头鞍和窄的边缘，但尾部是不同的，*Chiawangella* 具有窄的肋叶和三对边缘刺，而 *Crephicephalina* 具有一对边缘刺。*Chiawangella* 发生在上寒武纪早期，很可能是 *Crephicephalina* 的后裔或者是和 *Crephicephalina* 非常相关的属。

#### *Chiawangella pustulosa* Chu (新种)

(图版 V，图 4—7)

描述：头盖宽，凸起；头鞍长，近似卵形，迅速的向前收缩，前端圆润，由左至右强烈凸起，前部向下倾斜。具有两对头鞍沟：第一对非常短，靠近背沟处作成深坑；第二对颇长，宽，迅速向内向后变浅；背沟后部深，前端与前边缘沟併合；前边缘沟非常深而宽，清楚下陷；外边缘窄，凸起，成尖脊状；前缘略向前拱出；頸沟窄而深，略向后拱出；頸环在中部强烈凸起，并扩展，具有一个小中疣；固定颊中等凸度，其宽度大约为眼叶间头鞍宽度的三分之二，向着背沟倾斜陡峻；眼叶中等大小，新月形，位于相对头鞍中綫之后；眼脊清楚，从背沟向后倾斜伸延与轴綫形成一  $60^\circ$  的角；面綫前支从眼叶伸出，向前略收缩，切前边缘

成一半圓形的曲綫；后支不明。

尾部除邊緣刺外近似長梯形，向前變寬；中軸大，柱錐形，后端圓潤，強烈高出於肋葉之上，為非常深而寬的橫溝分成四個軸節和一個末葉，並附加一關節半環；背溝深而寬，肋葉窄，約為中軸寬度之半，具有兩對寬的肋溝；前面一對深而斜，後面一對微弱，頗窄；肋葉的關節環凸起，小，末端形成一細長的側刺；第二節是由第二至第四肋脊所形成的，非常大，直接向後傾斜伸延，末端形成一大而長的側刺；後邊緣板平，具有一對細長而短的邊緣刺；後緣直。

表面具小點。尤其是軸部具有許多大小不同的疣點。

特記：以上所描述的幾個頭蓋和尾部的標本，均是由蘇北賈汪煤田淺灰色灰岩中找到的，標本保存完美。

層位和產地：*Drepanura premesnili* 帶；江蘇北部賈汪煤田(Ls 56)。

### *Chiawangella pacifica* (Walcott)

(圖版 V, 圖 8—9)

1911 *Albertella pacifica* Walcott Smiths. Misc. Coll. Vol. 57, No. 4, pp. 76—77.

1913 *Albertella pacifica* Walcott, Research in China, Vol. 3, p. 106, Pl. 12, fig. 3.

1937 "*Albertella*" *pacifica* Resser et Endo, Manchurian Sci. Mus. Bull. No. 1, p. 163, Pl. 50, fig. 3.

描述：尾部除邊緣刺外作長柱錐形；中軸長，很大，近似柱錐形，為深而寬的橫溝分成七個軸節，由左至右凸起，後部向着平的后邊緣板下斜；背溝清楚；肋葉非常窄，平，約為軸葉寬度的三分之一，頗短；後緣略向後拱出。表面光滑。

比較：華克脫(Walcott)曾將此種尾部鑑定為 *Albertella*，是因為它具有邊緣刺。後來小林貞一(1935, p. 270)和雷士及遠藤(1937, p. 163)均指出將此種尾部確定為 *Albertella* 是成問題的，不僅因為尾部構造不同，而且因為美國的和亞洲的標本在地區上以及時代上分布的不同。目前，我們將此種歸入於 *Chiawangella* 是因為它和屬型的尾部構造和外形均很相似，兩者均具有三對邊緣刺。*Chiawangella* 的兩個種之間的一些其他細節的不同，我們考慮不能成為屬的特點，兩種之間有以下三點不同 1) *pacifica* 的尾部後緣向後拱出，而 *pustulosa* 的後緣是直的，2) *pacifica* 的尾部肋葉是較窄的，3) *pacifica* 表面光滑，而 *pustulosa* 表面具有疣點。

層位及產地：*Drepanura premesnili* 帶；遼寧省本溪田師付東腰堡(BE875)和遼寧省遼陽烟台五頂山(BE410)。

### 科 ?Menomoniidae Walcott, 1916

#### 屬 *Paramenomonia* Chu (新屬)

#### 屬型 *Paramenomonia conica* Chu (新種)

特征：後頰類三葉蟲具有近似長梯形之外形和光滑的表面；頭鞍錐形，具有三對微弱的頭鞍溝；背溝清楚；外邊緣凸起，前側端呈角度接觸；內邊緣窄，明顯陷下，在兩邊各具有一圓形的突起；頸環寬度均勻，頸溝清晰；固定頰常高起；眼葉小，位於相對頭鞍中綫之前；無眼脊；後翼近似三角形，其寬度幾乎等於頭鞍底部的寬度；面綫前支向前分歧和後支略

向后傾斜。

比較：*Paramenomonina* 与北美上寒武系下部 *Cedaria* 带和 *Crepicephalus* 带所产的 *Menomonina* Walcott 非常相似，它們具有相同的头鞍形式，寬的外邊緣，陷下的內邊緣，窄的固定頰和小的眼叶。其主要不同为 *Menomonina* 的面綫后支切头部后側邊緣于頰角之前即前頰类；同时 *Paramenomonina* 的面綫后支切后邊緣于頰角之內即后頰类。其次 *Paramenomonina* 的內邊緣虽然陷下，但在两边各具有一圓形的突起。再者 *Menomonina* 的后翼經常是較寬的和眼叶时常更靠于前部。

层位和产地：*Drepanura premesnili* 带；辽宁太子河流域。

### *Paramenomonina conica* Chu (新种)

(图版 V, 图 10—11)

描述：头盖凸起，近似梯形，前部的寬度較小于后部寬度的二分之一；头鞍凸起，錐形，其长度大約占头盖的三分之二；具有三对头鞍沟：第一对几乎水平向內伸出，第二对略向后傾斜，第三对強烈傾斜，与背沟成  $-60^\circ$  的角；背沟深；外邊緣凸起，前部略傾斜，后部为直的沟所限，但后側部为弧形沟所限；內邊緣窄，在头鞍前明显凹陷和在兩側边各具有一圓形的突起；頸环凸起，寬度均匀，較头鞍底部寬；頸沟在中部浅而直，向兩側变深和向前弯曲；眼叶小，恰位于相对头鞍中綫之前；无眼脊；固定頰窄，其寬度小于头鞍底部寬的二分之一；后側翼近似三角形，与头鞍寬度相等，兩側略傾斜。后邊緣沟寬；后邊緣窄而清楚，从背沟直接向外，略向后伸出；面綫前支从眼叶向外伸出，略分歧切前緣大約到形成一直角；后支长，向后向外傾斜伸延，切后邊緣于頰角之內。

表面光滑。

层位和产地：*Drepanura premesnili* 带；辽宁省辽阳烟台五頂山(BE 410) 和辽宁省本溪营子二道沟(BE 121)

超科 *Dikelocephalacea* Richter 1932, emend. Hupé 1953

科 *Anomocaridae* Poulsen 1927, emend, Hupé 1953

属 *Wutingshanina* Chu (新属)

属型 *Wutingshanina lui* Chu (新种)

特征：后頰类三叶虫，具有光滑的表面；头鞍短，截錐形，无头鞍沟；背沟在头鞍兩側深，在头鞍前部浅；前緣面长，凹下，向前扩展在前端形成一不尖的角；頸环寬度均匀；眼叶大，新月形，位于头盖的后部；眼脊明显。固定頰的寬度等于眼叶間头鞍的寬度；面綫前支分开，后向內強烈弯曲沿邊緣彼此相遇于前端，最后連成一縱綫横过腹邊緣；活动頰寬，平，邊緣很寬，由后側部伸出一大的頰刺，腹邊緣很寬，具有同心的細綫。

比較：*Wutingshanina* 可能是朝鮮南部 *Olenoides* 带所产的 *Haniwoides* Kobayashi 的后裔。它和后者均具有短而无沟的头鞍，寬而凹下的邊緣，相同形式的面綫和活动頰。但 *Haniwoides* 的头鞍是較寬的，近似四方形，眼叶更靠近头鞍和沒有眼脊。

另外，此新属和長山統所产的 *Lioparia* Lorenz 1906 亦略相似，但它以无沟的头鞍，向前扩展并在前端形成鈍角的邊緣，較大的眼叶，面綫的形式和較寬后邊緣与后者相区

別。

层位和产地: *Drepanura premesnili* 带; 辽宁省太子河流域。

### *Wutingshania lui* Chu (新种)

(图版 V, 图 12—15)

描述: 头鞍短, 中等凸度, 截锥形, 前端圆润, 约占有头盖长度的一半; 无头鞍沟; 背沟在头鞍两侧深, 向前向内变浅, 和在头鞍前部仅隐约可见。前缘面约占有头盖长度的三分之一, 向前侧部扩展, 略凹下, 但近前缘处又升起; 不分内外边缘, 亦即无边缘沟; 前缘从前侧角向内略向前伸延, 在中部形成一钝角。颈沟清晰, 横直; 颈环宽度均匀, 略凸起。眼叶大, 新月形, 位于头盖后部; 眼脊清楚, 短, 从背沟相对头鞍前部四分之一处伸出, 略向后倾斜。固定颊略凸起, 其宽度约为头鞍底部宽度的三分之二; 后边缘窄, 宽度一致; 后边缘沟明显; 活动颊比较大, 几乎是平的, 具有宽的边缘; 颊刺短, 约长于活动颊全长的三分之一, 腹边缘非常宽, 具有许多同心的细线, 平行于边缘。面线前支长, 从眼叶向前伸出, 略分开, 后又近于前缘处强烈向内弯曲和在前部略向前伸延彼此相遇于中部, 最后连合成一单独的纵线横过腹边缘; 后支很短, 从眼叶后端略向后倾斜伸出, 切后边缘于颊角之内。

表面光滑。

特记: 此种在辽宁太子河流域非常多而普遍, 但没有在其他地方发现。

层位和产地: *Drepanura premesnili* 带; 辽宁省辽阳烟台五顶山 (BE 410) 和辽宁省本溪营子二道沟 (BE121)。

### 科 *Dikelocephalidae* Miller, 1890

#### 亚科 ?*Dikelocephalinae* Beecher 1897 emend. Hupé 1953

#### 属 *Liaoningaspis* Chu (新属)

#### 属型 *Liaoningaspis taitzeensis* Chu (新种)

特征: 头鞍近似柱形, 后部略变宽; 头鞍沟微弱; 在头鞍后侧部, 背沟外边具有一对小的、卵形的边叶; 内边缘很宽, 长, 略凹下, 近前缘略上翘, 前缘边上具有不规则的, 同心的细线纹, 后部以一低而清楚的脊线头鞍分开, 并且此脊线近似平行于前缘; 颈环上有一个小疣; 眼叶大, 位于相对头鞍中线之后; 固定颊小; 活动颊大; 颊角圆润; 胸部不明, 尾部中等凸度, 较宽; 中轴突出, 柱锥形, 由六个轴节和一个关节半环组成; 肋叶近似三角形, 具有 4—5 对肋沟; 后边缘宽, 略凹下, 沿边缘具有不规则的同心的细线纹; 腹边缘宽, 在表皮脱落的标本上见有不规则的接合的细线纹。

比较: 此属和 *Paracoosia* Kobayashi 1936 非常相似, 其不同点在于前者具有近似柱形的头鞍, 在头鞍后侧角出现一对卵形的边叶, 在活动颊上没有颊刺和在尾部侧边缘有两对小的锯齿形的刺。

从 Canada, Quebec 的 Levis 砾岩中所产的 *Lauzonella* Rasetti 1944 和此新属亦略相似, 但前者以较狭的固定颊, 在头鞍后侧角没有卵形的边叶, 较狭的尾轴和圆润的尾部前侧角与 *Liaoningaspis* 相区别。

*Liaoningaspis* 与发生在长山統中的 *Lioparia* Lorenz 1906 和 *Dikelocephalites* Sun 1935 均很接近,但此新属与二者不同之点为較狹的边緣,固定頰上具有一对特殊的小边叶和头鞍前緣具有一低的脊綫,以及在尾部两侧具有两对小的鋸齿形的刺。它和 *Dikelocephalites* 的区别,在于微弱的、不連接的头鞍沟和比較寬的固定頰。

层位和产地: *Blackwelderia paronai* 带; 辽宁省太子河流域,内蒙清水河和山东省嘉祥县。

### *Liaoningaspis taitzehoensis* Chu (新种)

(图版 VI, 图 1—9)

描述: 头盖近似四方形; 头鞍凸出, 較长, 近似柱形, 向前略收縮, 前端圓潤和沿軸部略凸起; 具有两对浅、微弱而傾斜的头鞍沟; 背沟窄但清楚, 頸沟窄, 浅, 中部略向后拱出; 頸环中等寬度, 凸出, 在中部靠前具有一个小疣; 内边緣略凹下, 近前緣处則又略上翘, 其寬度相等于是眼叶間的距离, 其长度大約等于头盖长的三分之一, 沿边緣具有不規則的同心綫紋; 内边緣后部以一低而清楚的脊綫与头鞍前緣分开, 此脊綫沿头鞍前緣向两侧伸延, 成一光滑的曲綫; 眼叶大, 恰位于头盖中綫之后; 眼脊微弱。固定頰略凸起, 其寬度約为头鞍底部寬的一半, 在靠近背沟于头鞍后側角具有一对小的、卵形的边叶。

活动頰大, 眼板窄, 具有一寬而凹下的側边緣, 其上沿外緣边具有不規則的綫紋; 頰角圓潤; 无頰刺。

面綫前支从眼叶伸出, 向前分歧, 然后強烈向内弯曲, 切前緣成一半圓形的曲綫; 后支短, 直接向外伸出, 后又強烈向后弯曲切后边緣于頰角之内。

胸部不明。

尾部近似橫橢圓形, 中等凸度, 短, 其长度約为寬度的一半; 中軸窄, 凸出, 柱錐形, 向后收縮, 后端圓潤, 具有五个軸节和一个关节半环及一末叶; 肋叶近似三角形, 具有四对肋沟, 其中第一对, 第二对, 第三对是較长而明显的, 第四对非常短, 并且不清楚; 后翼寬, 略下凹, 沿后緣飾有不規則的, 同心的細綫紋, 两侧并具有两对鋸齿形的小刺; 腹边緣非常寬, 具有許多接合的細綫紋, 或多或少与边緣平行。

表面光滑。

层位和产地: *Blackwelderia paronai* 带; 辽宁省本溪营子北駱駝岭子 (BE 385); 辽宁省辽阳烟台当十岭 (BE448); 山东省嘉祥。

### *Liaoningaspis* sp.

(图版 II, 图 10)

一个被压平, 保存不完全的尾部标本, 和属型的尾部一样在两侧出現有两对鋸齿形小刺, 边緣非常寬, 但此尾部的軸叶是較寬的和肋沟是較向后傾斜, 由于标本保存的很不好, 我們不能給以确切的种名。

层位和产地: *Blackwelderia paronai* 带(?); 内蒙清水河。

科 *Dikelocephalidae* Miller, 1890亚科 *Osceolinae* Ulrich et Resser, 1930属 *Walcottaspidella* Chu (新属)属型 *Walcottaspidella suni* Chu (新种)

特征:头鞍近似方形,略凸起;无头鞍沟;内边缘中等大小,凹下,沿边缘又略上翘,前缘向前略凸出;背沟很浅;颈沟在中部深,向两侧变浅,并形成一宽的V字形式样;颈环略凸起,中部窄,向两侧变宽,具有一小的中疣;眼叶中等大小,新月形,位于头盖中缘之后;眼脊微弱。固定颊几乎平坦,狭,相对头鞍两后侧角有一小的半圆形的边叶;面线前支略向前分歧。

尾部作椭圆形,中等凸度;肋部微弱的分成为5对肋脊,边缘非常宽,略凹下。

比较: *Walcottaspidella* 和从北美 Trempealeamian 所产的 *Walcottaspis* 非常近似,由于均具有一个短而无沟的头鞍,但此新属具有圆润的内边缘,中部窄的颈环和略向前分歧的面线前支。再者 *Walcottaspidella* 在固定颊上具有一对小的边叶。在某些特点上此新属和 *Liaoningaspis* 亦相似。但它们主要不同之点在于头鞍的式样,固定颊的大小,内边缘的长度和面线的形式。*Walcottaspidella* 的尾部和 *Liaoningaspis* 的尾部是非常相似,两者的轮廓大致相同和均无有间肋沟,但 *Walcottaspidella* 在两侧边缘无边刺。

层位和产地: *Drepanura premesnili* 带;辽宁省太子河流域。

*Walcottaspidella suni* Chu (新种)

(图版VI, 图11, 12)

描述:头盖近似方形,略微凸起;头鞍略凸起,较长,近似方形,向前略微收缩;前侧角圆润;头鞍沟非常微弱,仅后一对在倾斜尖之下可以看到,在头鞍后部四分之一处,从背沟向内向后对着颈沟倾斜伸延,与头鞍相交形成一直角三角形;内边缘凹下,近边缘处又略上翘,其宽度比眼叶间距离较窄,其长度约占头盖全长的五分之一;前缘略向前拱出,形成一光滑的凸出的曲线。颈沟作宽V字形,中部颇深,向两侧变浅和略向前倾斜;颈环在两侧较宽,向中部变窄,中部并具有一个小疣,后缘边略向后拱出;眼叶中等大小,弓形,位于头鞍中缘之后;眼脊微弱,从背沟相对头鞍前部四分之一处伸出,是一低而弱的脊线,向后倾斜;固定颊狭,略微凸起,大约为头鞍宽的四分之一,靠近背沟,相对头鞍后叶具有一小而不清的、半圆形的边叶;后翼没有完全保存,略凸起,以一明显的边缘沟与窄的后边缘分开;面线前支略向前分歧,切前边缘成一圆角。

胸部不明。

尾部宽,长椭圆形,前缘向后弯曲相等,后缘拱起,略弯曲;轴叶不完全,仅保存有小部分末叶,轴叶长度约为尾的四分之三,近似锥形,末端圆润。肋叶宽,三角形,表面凸起;有一个宽而凹下然后又变成水平,平坦的外边缘,外边缘近边缘处具有同心的细线;从背沟倾斜伸出五对浅的肋沟,伸至平的边缘处尖灭;腹边缘宽,装饰有细线。

特记:这个种的建立仅以两个不完全的头盖和一个尾部,但是它很显然是一个较特殊



的种。

层位和产地：*Drepanura premesnili* 带。辽宁本溪田师付东腰堡。

### 屬 *Kushanopyge* Chu (新屬)

#### 屬型 *Kushanopyge serrata* Chu (新种)

特征：尾部近似椭圆形；軸叶窄，近似錐形，強烈凸起，高出于肋叶之上，約占尾部全长的四分之三，以横沟分成为七个軸节，横沟在軸叶中部是頗浅的，末节近似三角形，在軸綫两边具有一低的突起脊；肋叶在内部之半略凸起，向边缘傾斜；边缘寬，略凹下和肋叶上具有七对或更多对平頂的肋脊；肋沟弯曲，連續伸延，从背沟或多或少向外变寬；每个肋脊的末端具有一窄的、鋸齿形的刺；腹边缘寬，其上具有同心的細綫。表面光滑。

比較：此属虽然仅仅是发现其尾部而无头部，但是非常特殊的；笔者在上寒武紀早期动物羣中还没有見到任何象此尾部的种属，因此必須給以新的属名。*Kushanopyge* 的尾部以寬的，凹下的而无边的边缘和具有鋸齿的后緣与美国上寒武系所产的 *Hungatia* Walcott 和欧洲中部特馬豆克所产的 *Hungatoides* Kobayashi 相似，但它以尾部外形和軸叶的大小与后二属相区别。*Kushanopyge* 亦可和 *Drepanura* Bergeron 做一比較，但后者具有平的边缘，一对大的镰刀形的边缘刺和不同形式的肋沟。

层位和产地：崑山統；辽宁太子河流域和华北。

#### *Kushanopyge serrata* Chu (新种)

(图版Ⅶ，图 13—14)

1913 *Pterocephalus asiaticus* Walcott, Research in China, vol. 3, p. 146, Pl. 14, figs. 5a, 5b. only.

此种发现于辽宁省辽阳烟台煤矿当十岭的 *Blackwelderia paronai* 带，是一些尾部。Walcott 从山东曾找到过两个破碎的尾部(1913, p. 146, Pl. 14, figs. 5a, 5b)鑑定为 *Pterocephalus asiaticus*，我們认为与此新种是同种的。与这两个尾部在一起的还有一保存不完全的头部(Walcott 1913, Pl. 14, fig. 5)，曾被小林貞一(1936, p. 172)归入于 *Paracoosia* Kobayashi 但是这些尾部与 *Paracoosia* 的属型 *P. mansuyi* Kobayashi 是很不相同的，在于具有一鋸齿形的后緣。

### 超科 Olenacea Hupé, 1953

### 科 Leiostegiidae Bradley, 1925

### 屬 *Chuangioides* Chu (新屬)

#### 屬型 *Chuangioides punctatus* Chu (新种)

特記：此属与长山統所产的 *Chuangia* 非常近似，并认为它具有 *Chuangia* 的祖先的形式，但是此属的外形是近似椭圆形，而 *Chuangia* 是半圆形或半椭圆形，和此属表面上具有許多細小的疣点和小坑。象 *Chuangia* 一样，此属的肋沟是短的，但极其明显和深的。再者 *Chuangia* 的尾部前側角或多或少是成尖角的，但在 *Chuangioides* 内是十分圓潤的，并做成半圆形的曲綫。除上述少数的特点之外，此属軸叶的形式或无边的边缘的是沒有变化的，这些少数的特点足够的区别为两个明显的属。更詳細的特征将叙述在属型的描述中。

地質和地理分布: 崑山統, 山西省。

### *Chuangioides punctatus* Chu (新种)

(图版Ⅶ, 图 1—2)

描述: 尾部近似椭圆形, 其长度少于最大宽度的三分之一; 軸叶強烈凸起, 近似錐形, 高出于肋叶之上, 約占尾部长度的三分之二較多些, 由橫沟分成为 4—5 軸节; 第一和第二橫沟深而窄, 并略向前拱出, 后部的沟是微弱的; 背沟在两侧深, 并迅速向后变浅, 对着窄而圓潤的后叶收縮; 肋叶凸起, 分成为一个窄的关接节, 三个短的肋脊和一个寬的后部, 第一对或者是关接沟是长而寬的, 第二对和第三对是短的, 但是頗深的, 第四对沟是浅的; 表面具有許多細小的疣点和小坑。

比較: 此种是发现于山西隰县, 为几个保存在灰岩中的尾部所代表。它发现于山西西部 *Blackwelderia paronai* 带内但并不普遍。仅有此一个种。

层位和产地: 崑山統下部, 与 *Blackwelderia paronai* (Airaghi), *Lorenzella parabola* Lu 等相共生; 山西省隰县石口鎮云梦山(SK18a, SK18 和 SK19)。

### 未鑑定的 Damesellidae 三叶虫

#### 种屬未鑑定的 Damesellid 1

(图版Ⅶ, 图 11—13)

描述: 尾部寬, 其寬度大約为长度的四倍; 軸叶凸出, 錐形, 长, 在后部突然收縮, 形成一短而窄的脊, 此脊向后对着边缘伸延, 由弯曲的橫沟分成为五个軸节; 背沟深而窄; 肋叶三角形, 比軸叶較寬, 具有 3—4 对肋脊; 肋沟深而寬; 間肋沟在前部的肋脊上是微弱的; 具有六对短的边缘刺, 其中以第三对最短和頗細的, 以第六对最大; 此外第一对和第二对边缘刺几乎是直接向后伸出, 后部的刺則向內傾斜伸延。边缘窄。

比較: 因为沒有找到其头部, 所以此类尾部归入何属中是很难决定的。它和皮正龙(1899, p. 508, Pl. 13, fig. 7)和华可脱(1913, p. 116, Pl. 8, figs. 4, 4a)所描述的和图示的 *Stephanocare? sinensis* 非常相似, 但是它与后者不同之处为寬的軸叶, 非常狹的边缘和后部的刺是直接向內傾斜伸延而不是向后。此两类尾部以寬的外形和大的三角形的末刺而不能归入于所知道的 Damesellidae 科的任何属之內。

层位和产地: *Drepanura premesnili* 带, 辽宁省辽阳烟台五頂山 (BE410)。

#### 种屬未鑑定的 Damesellid 2

(图版Ⅶ, 图 5—8)

尾部寬, 椭圆形, 其长寬的比例大約为 1:3。軸叶三角形, 中等凸度, 窄, 規則而迅速的向后收縮, 末端近于边缘, 由橫沟分成为 7—8 个軸节; 肋叶寬, 平, 具有 3—4 肋节; 肋沟在内部深, 近于边缘处則不見; 无清楚指示的边缘, 具有六对长度大約相等的锯齿形的边缘刺。腹边缘很寬。

比較: 此类尾部实际上和 *Drepanura pusilla* Resser et Endo (1937, p. 217, Pl. 50, fig. 1; Pl. 63, figs. 14, 15, Pl. 64, figs. 2, 3.) 很相似, 但小林貞一(1941, p. 46) 曾指出后者

属的鑑定是有怀疑的，因为此种尾部缺失 *Drepanura* 做为最重要特征的第一对大的对边缘刺。

层位和产地：*Drepanura premesnili* 带，辽宁省本溪营子二道沟 (BE121) 和辽阳烟台五頂山 (BE410)。

### 种属未鑑定的 Damesellid 3

(图版Ⅶ，图 3—4)

此类尾部是从辽宁省本溪营子二道沟的 *Drepanura premesnili* 带的頁岩中找到的。沒有发现其头部。它与雷士和远藤所描述的 *Drepanura inutilis* (1937, p. 215, Pl. 50, fig. 2) 相似，但似乎不同种。一般的說它和 *Drepanura* 最为近似比 Damesellidae 科其他的属，在于它具有短的軸叶和非常大的第一对肋脊，但是象 *D. inutilis* 一样，它和 *Drepanura* 的区别是缺失第一对长的边缘刺。

### 种属未鑑定的 Damesellid 4

(图版Ⅶ，图 9—10)

这两个尾和图版Ⅶ图 5—8 种属未定的 Damesellid. 2 很相似，但此尾部与后者不同之处在于有一个較短的軸叶，直而短的前边缘和向后傾斜的前侧边缘。

层位和产地：*Drepanura premesnili* 带；辽宁省本溪营子二道沟 (BE121)。

## 科 Saukiidae Ulrich and Resser, 1933

### 种属未鑑定的 Saukid 头盖

(图版Ⅶ，图 14)

从山西隰县所找到的一个小的头盖，在崗山統三叶虫的各属中是沒有一个可以和它相比較的；此头盖与 Saukids 一类三叶虫非常相近，但是，因为标本是很小的和保存的不够好，所以目前我們还很难鑑定出确切的属名和种名。笔者仅将此头盖作一簡短的描述和照象以供参考。并且将它暂时归入于 Saukiidae 科之内。

头鞍凸起，近似柱形，具有四对不連續的、浅而短的头鞍沟；頸沟明显，深，頸环宽度均匀；外边缘窄，凸出，与头鞍为一深的边缘沟分开；固定頰非常窄，其宽度約小于头鞍底部寬的三分之一；眼叶中等大小，位于头鞍相对的中部，无眼脊。表面具有疣点。

### 种属未鑑定的 Saukid 尾部

(图版Ⅶ，图 15)

标本仅仅是一个 Saukid 三叶虫幼虫的尾部；尾部小，半圓形，其长度为 1.8 毫米，寬为 3 毫米。軸叶由 7 个軸节組成，強烈凸起，柱錐形，逐漸向后收縮，但在后部突然收縮成一窄的，短而低的脊，此脊近于边缘处則不見。肋沟中等凸度，向着边缘板略下傾，由肋沟分成为 4—5 对肋脊；前部的肋沟是頗深的，从背沟伸出略向后傾斜，然后在外部一半的地方強烈向后弯曲并尖灭于边缘沟上；間肋沟微弱，大約在肋脊一半的长度上可以看到；在軸部的表面上具有粗大的疣点和肋叶上具有較細小的疣点。

此尾部是从江苏北部賈汪煤田的 *Drepanura premesnili* 带的浅黄色灰岩中获得的;标本的每个特点和 Saukiidae 科三叶虫是相关系的,如肋脊的特征和伸延的情况,凹下的边缘板,明显的后部轴脊和表面的装饰。笔者考虑它是 Saukid 的年青的型式,因为标本还是相当小的,所以很难肯定它确切的关系。

# TRILOBITES FROM THE KUSHAN FORMATION OF NORTH AND NORTHEASTERN CHINA

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(With 7 Plates)

## INTRODUCTION

The material on which this paper is based is largely collected in 1950 by Y. Wang, Y. H. Lu, K. C. Yang, A. T. Mu, and J. C. Sheng from the Kushan Formation of the Taitzeho valley of Liaoning, NE China. A part of the specimens were collected during the past few years by Y. H. Lu and N. T. Tung from the type-locality of the Kushan Formation in Shantung and by J. C. Sheng from the same formation of the Chiawang Colliery of northern Kiangsu and Yunmengshan of Hsihsien, western Shansi. Other specimens were collected by F. H. Chia and C. L. Kao from the Tsingshuiho district of SE Inner Mongolia. The material is of special importance, since there are nine new genera and one subgenus described.

The term "Kushan shale" erected by Willis and Blackwelder in 1907. This is a green shale with thin shaly and conglomeritic limestones with abundant remains of trilobites. The thickness is about 15—45 meters. The geological age of the "Kushan shale" was considered by Willis and Blackwelder to be Middle Cambrian. The shale series is divided by Prof. Y. C. Sun in the Wenho region of Taian, Shantung in 1937, on the basis of faunal evidence, into two parts; the upper part is called the Kushan Formation and the lower, the Wenshui Formation. The Kushan Formation comprises, according to Sun, two faunal zones: the zone with *Drepanura* in the upper part and the zone with *Blackwelderia* in the lower. The Wenshui Formation can also be divided into two zones; the upper one is named the zone of *Damesella* and the lower one, the zone of *Amphoton*. Sun considered that the boundary line of the Upper and Middle Cambrian should be placed at the base of the *Blackwelderia* zone. Recent find of a basal conglomerate on the erosional surface of the Changhia limestone at several localities of Penchi, Liaoning by Wang and his party clearly indicates that there occurs a hiatus between the zone of *Damesella* and zone of *Blackwelderia* and thus confirms the view of Prof. Sun. The Kushan Formation belongs in our opinion undoubtedly to be Upper Cambrian age. (see also Lu 1954). The Kushan fauna from the biological point of view shows also obviously a much closer kinship with the overlying Upper Cambrian Changshan fauna than with the underlying Changhia fauna of the Middle Cambrian age. In addition to the two characteristic Upper Cambrian genera *Homagnostus* and *Pseudagnostus*, the new genus *Liaoningaspis* described in the present

paper bears a strong resemblance to *Lioparia* Lorenz and *Dikelocephalites* Sun of the Changshan Formation. And furthermore, a typical Kushanian trilobite *Stephanocare* has been found in association with *Changshania* in the Tapashan region of Northern Szechuan. All available evidences lead the writer to believe that the Kushan Formation (in restrict sense) belongs to the basal part of the Upper Cambrian in North and Northeastern China. According to the vertical distribution of the trilobites illustrated in this paper, it seems natural to consider the Kushan Formation to be contemporaneous with the *Agnostus pisiformis* zone of Scandinavian region. In this connection, it should be pointed out that the *pisiformis*-zone in Sweden contains also *Drepanura* which is a characteristic fossil of the Kushan Formation.

On the basis of the stratigraphical sequence and faunal succession in North and Northeastern China, two faunal zones of the Kushan Formation may be distinguished, viz.—

**Upper zone: *Drepanura premesnili* zone**

**Lower zone: *Blackwelderia paronai* zone**

The above classification is the same as suggested by Y. C. Sun in 1937. In addition to the above two faunal zones, a subzone, i.e. the subzone of *Diceratocephalus* has been established in 1954 for the upper part of the *Drepanura premesnili* zone by Y. H. Lu and N. T. Tung. The genus *Diceratocephalus* is certainly a solitary endemic form confined to the Taitzeho region of South Manchuria.

The writer tenders her sincere thanks to Messrs Y. Wang, Y. H. Lu, K. C. Yang, A. T. Mu, J. C. Sheng of the Institute and F. H. Chia and C. L. Kao of the Ministry of Geology for their courtesy in placing the collections at her disposal. Hearty thanks are also due to Profs. H. C. Sze and Y. H. Lu for careful reading of the manuscript.

### Stratigraphic Summary

A. The sections of the Taitzeho Valley, Liaoning, Northeastern China:

**1. The Yaopu section:** This section is measured at Yaopu, Tienshihfu of Penchi district. The details of the succession reading from top downward are as follows:—

Super-formation: Changshan Formation.

(2) Purplish-red wormkalk intercalated with yellow shales (largely covered) 8 m.

(1) Reddish-purple shales and yellow limestones, occasionally with Öolitic limestones

Middle Cambrian

8 m.

Changhia Formation—Grey, crystalline limestones.

— Fault.

## Upper Cambrian

Kushan Formation—Same as (2), yielding three horizons of fossils in descending order:

BE874

*Blackwelderia paronai* (Airaghi)

BE875

*Drepanura premesnili* Bergeron*Diceratocephalus armatus* Lu*Pseudagnostus douvillei* (?) (Bergeron)*Chiawangella pacifica* (Walcott)*Blackwelderia sinensis* (Bergeron)

BE876

*Blackwelderia paronai* (Airaghi)*Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (Subgen. et sp. nov.)*Homagnostus* (*Quadrahomagnostus*) *tienshihfuensis* Chu (Subgen. et sp. nov.)*Blackwelderia sinensis* (Bergeron)*Lorenzella subcylindrica* Chu (sp. nov.)*Pseudagnostus douvillei* (Bergeron)*Kushanopyge serrata* Chu (gen. et sp. nov.)*Blackwelderia mui* Chu (sp. nov.)*Blackwelderia* cf. *octaspina* (Kobayashi)

**2. The Erhtaokou section:** Erhtaokou is situated at about 3 km east of Huolienchai and 1 km north of Yingtze, Penchi district. Here the Kushan Formation is underlain disconformably by the Changhai limestones and is overlain by the Changshan Formation without any noticeable break. The details of the succession reading from top downward are as follows:

Super-formation: Changshan Formation

(4) Purple and yellow calcareous shales, the lower part is intercalated with limestones, yielding four horizons of fossils in descending order:—

BE121

*Pseudagnostus* sp.*Homagnostus taitzeoensis* Chu (sp. nov.)*Drepanura premesnili* Bergeron*Diceratocephalus armatus* Lu*Taitzeoia wangi* Chu (Gen. et sp. nov.)*Taitzeoia erhtaokouensis* Chu (gen. et sp. nov.)*Liostracina krausei* Monke*Blackwelderia sinensis* (Bergeron)*Paramenomonia conica* Chu (gen. et sp. nov.)*Wutingshanian lui* Chu (gen. et sp. nov.)

*Teinistion* sp. (bad preserved)  
*Blackwelderia paronai* (Airaghi)  
*Blackwelderia shengi* Chu (sp. nov.)

BE122

*Blackwelderia sinensis* (Bergeron)  
*Blackwelderia shengi* Chu (sp. nov.)  
*Diceratocephalus armatus* Lu

BE123

*Blackwelderioides monkei* (Walcott)  
*Blackwelderia paronai* (Airaghi)  
*Blackwelderia sinensis* (Bergeron)  
*Lorenzella* sp.

*Liostracina krausei* Monke  
*Stephanocare richthofeni* Monke  
*Drepanura premesnili* Bergeron  
*Blackwelderia liaoningensis* Chu (sp. nov.)

BE124

*Blackwelderia paronai* (Airaghi)

(3) Grey, well-bedded brittle limestones with layers of öolitic limestones and edgewise limestones

(2) Dark purple calcareous shales

(1) Öolitic and siliceous limestones: the upper part is dark purple in color, the middle part is characterized by thin-bedded and dolomitic limestones and the lower part by purple shales. The basal part is represented by a thin layer of fine conglomerate. Middle part contains two fossil horizons.

BE125

*Lorenzella parabola* Lu  
*Blackwelderia sinensis* (Bergeron)

BE126

*Lorenzella parabola* Lu  
*Blackwelderia sinensis* (Bergeron)  
*Homagnostus convexus* Chu (sp. nov.)  
*Lotagnostus*(?) sp.

*Teinistion yangi* Chu (sp. nov.)

Sub-formation: Changhai Limestone

**3. The Lotolingtze section:** At Lotolingtze, about 3 km. in the NE of Erhtaokou section, the Kushan Formation is here well exposed. The thickness exceeds 30 m. It may be subdivided into three horizons as follows:

Super-formation: Changshan Formation

(3) Brown, purplish-grey shales

(2) Yellowish grey and grey nodular limestones and purplish grey calcareous



shales, the upper part is characterized by bluish grey shales. It yields three beds of fossils in descending order:

BE385

*Liaoningaspis taitzeensis* Chu (gen. et sp. nov.)

*Blackwelderia paronai* (Airaghi)

*Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (Subgen. et sp. nov.)

BE386

*Lorenzella parabola* Lu

*Pseudagnostus douvillei* (Bergeron)

*Blackwelderia sinensis* (Bergeron)

BE387

*Blackwelderia paronai* (Airaghi)

*Lorenzella parabola* Lu

*Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu (Subgen. et sp. nov.)

*Blackwelderia paronai* var. *penchiensis* Chu (var. nov.) 10 m.

(1) Basal conglomerate containing various limestone-pebbles of irregular shapes; matrix composed of purplish-red ferruginous material and occasionally öolitic calcareous deposits 0.6 m.

Sub-formation: Changhia Limestone

**4. The Tangshihling section:** The Tangshihling section is exposed about 6 km. SE of the Yentai Colliery, Liaoyang. In the western part of this section, the Kushan Formation consists of the following beds:—

Super-formation: Changshan Formation

(4) Yellow and green shales, yielding *Pseudagnostus douvillei* (Bergeron), *Drepanura premesnili* Bergeron, *Diceratocephalus armatus* Lu, *Liostracina krausei* Monke (BE439, BE452). 13.7 m.

(3) Grey thin-bedded limestones, partly öolitic, yielding *Drepanura ketteleri* Monke, *Stephanocare richthofeni* Monke, *Lorenzella pustulosa* Chu (sp. nov.), *Liostracina krausei* Monke, *Blackwelderia paronai* (Airaghi) (BE449)

(2) Yellowish grey nodular limestones and lenticular limestones, containing *Blackwelderia paronai* (Airaghi), *Liaoningaspis taitzeensis* Chu (gen. et sp. nov.), *Lorenzella parabola* Lu, *Blackwelderia paronai* var. *penchiensis* Chu (var. nov.) (BE448) 6 m.

(1) Dark purple and grey shales, containing *Stephanocare richthofeni* Monke, *Homagnostus taitzeensis* Chu (sp. nov.), *Teinistion tangshihlingensis* Chu (sp. nov.), *Teinistion yangi* Chu (sp. nov.), *Tangshihlingia subtriangulata* Chu (gen. et sp. nov.) (BE438) 5.1 m.

Sub-formation Changhia limestone

**5. The Wutingshan section:** This section is exposed about 5 km. south of the Yentai Colliery, Liaoyang. From this section, four horizons of the Kushan fauna have been collected. The base of the Kushan Formation is not exposed, the faunal

succession is essentially like those of the preceding section:

Super-formation: Changshan Formation

(5) Yellow and green shales, containing *Pseudagnostus douvillei* (Bergeron), *Drepanura premesnili* Bergeron, *Diceratocephalus armatus* Lu, *Diceratocephalus latifrons* Lu, *Homagnostus taitzeohensis* Chu (sp. nov.), *Blackwelderia sinensis* (Bergeron), *Liostracina krausei* Monke, *Paramenomonia conica* Chu (gen. et sp. nov.), *Wutingshanian lui* Chu (gen. et sp. nov.), *Taitzeohia wangi* Chu (gen. et sp. nov.), *Taitzeohia erhtaokouensis* Chu (gen. et sp. nov.), *Teinistion yangi* Chu (sp. nov.), *Parashantungia elongata* Chu (subgen. et sp. nov.) (BE409, BE410). 10 m.

(4) Brownish yellow and greenish yellow shales, containing *Pseudagnostus douvillei* (Bergeron), *Blackwelderia sinensis* (Bergeron), *Blackwelderia* (?) sp., *Drepanura premesnili* Bergeron, *Blackwelderia paronai* (Airaghi), *Liostracina krausei* Monke (BE414). 2.6 m.

(3) Yellow and greyish yellow calcareous shales, occasionally with limestone nodules, yielding *Pseudagnostus douvillei* (Bergeron), *Liostracina krausei* Monke, *Drepanura ketteleri* Monke, *Blackwelderia sinensis* (Bergeron) (BE413). 3.5 m.

(2) Yellow and greenish yellow nodular limestone and yellow calcareous shale. 4.7 m.

(1) Light grey thin-bedded limestone with fragment of trilobite. 7 m.  
Base not exposed.

#### B. The Kushan Region of Shantung Province:

The Tangwangchai section:—Tangwangchai is situated at about 1.5 km. NE of Kushan, Shantung. Here the Kushan Formation is separated from the top downwards into following beds:

Super-Formation: Changshan Formation

(3) Light grey, orange yellow and green shales, intercalated with calcareous nodular limestones. The following species have been found from the shales: *Drepanura premesnili* Bergeron, *Drepanura ketteleri* Monke, *Blackwelderia sinensis* (Bergeron), *Shantungia spinifera* Walcott, *Metashantungia brevicata* Chang, *Pseudagnostus douvillei* (Bergeron), *Liostracina krausei* Monke (BW37). 4 m.

(2) Bluish grey slabby limestones 8 m.

(1) Green shales intercalated with a few purple shales and 1 to 2 layers of edge-wise limestone conglomerate and lenticular limestone. The lenticular limestones yields *Blackwelderia sinensis* (Bergeron), *Lorenzella kushanensis* Chu (sp. nov.), Agnostids (BW36).

Sub-formation: Changhia Formation

#### C. The section of the Chiawang Colliery, Northern Kiangsu:

1. The section from Pangchiawa to Huamiaotsun: This section is measured

from Pangchiawa to Huamiaotsun, about 7.5 km. SW of Chiawang Colliery.

Super-Formation: Changshan Formation

(6) Grey thin-bedded limestones intercalated with a few öolitic and conglomeratic limestones, containing *Damesellinae* trilobites (Ls67). 22 m.

(5) Grey, thin-bedded, fine crystalline, öolitic and non-öolitic limestones intercalated with thin-bedded limestones and edgewise limestone conglomerate. Middle part yielding *Lorenzella parabola* Lu (Ls51). 23 m.

(4) Grey thick-bedded, hemicrystalline limestones intercalated with banded edgewise limestones, containing *Blackwelderia paronai* (Airaghi), *Lorenzella parabola* Lu (Ls50). 2 m.

(3) Grey crystalline limestones with small green spots, yielding *Blackwelderia paronai* (Airaghi), *Drepanura*(?) sp. (Ls7), *Damesops convexus* Chu (gen. et sp. nov.) (Ls49). 0.5 m.

(2) Purple, green hard limestones, containing *Blackwelderia* sp. (Ls31). 0.7 m.

(1) Thin-bedded, argillaceous limestones. 3.8 m.

Sub-formation: Changhia formation

**2. The Wangkolo section:** This section is measured at a limestone quarry situated at western part of Wangkolo, Chiawang Colliery.

Super-formation: Changshan Formation

(3) Grey thin-bedded limestones.

(2) Grey well-bedded, hard öolitic limestones and non-öolitic limestones, with purple limestone at the base, yielding *Stephanocare richthofeni* Monke, *Liostracina krausei* Monke, *Chiawangella pustulosa* Chu (gen. et sp. nov.), *Drepanura transversa* Chu (sp. nov.) (Ls56). 29 m.

(1) Thin-bedded, grey limestones. 3 m.

**3. The Tahuangshan section:** This section is measured at the southern slope of Tahuangshan, about 1 to 1.5 km. south of Wangkolo, Chiawang Colliery.

Super-formation: Changshan Formation

(3) Grey-thin-bedded limestones, yielding *Drepanura premesnili* Bergeron (Ls 25). 20.1 m.

(2) Thin-bedded, purplish brown limestones and öolitic limestones, yielding *Homagnostus convexus*(?) Chu (sp. nov.), *Blackwelderia* sp. *Liostracina kuausei* Monke (Ls58), *Damesellinae* trilobites (Ls59). 26 m.

(1) Thin-bedded grey limestones.

D. The Yunmengshan section of Shihkouchen, Hsihsien district, W. Shansi:

Super-formation: Slabby argillaceous limestones intercalated with edgewise limestones.

Thin-bedded argillaceous slabby limestones of 31.7 m in thickness, intercalated with öolitic bands and conglomeratic limestones, containing:

Sk18A

*Chuangioides punctatus* Chu (gen. et sp. nov.)

Sk18

*Blackwelderia paronai* (Airaghi), *Lorenzella parabola* Lu *Chuangioides punctatus* Chu (gen. et sp. nov.), *Dorypygella hsihsienensis* Chu (sp. nov.)

Sk19

*Chuangioides punctatus* Chu (gen. et sp. nov.),

*Liaoningaspis*(?) sp.

Sub-Formation: Grey, coarse-grained öolitic limestones.

A table of the geographical and stratigraphical distribution of the fauna elements is given in the Chinese text on page.

## DESCRIPTION OF SPECIES

**Superfamily Agnostacea Salter, 1864**

**Family Agnostidae (Corda, 1847) Salter, 1864**

**Subfamily Agnostinae Jaekel, 1909**

**Genus *Homagnostus* Howell, 1935**

**Genotype: *Agnostus pisiformis obesus* Belt, 1867**

***Homagnostus convexus* Chu (sp. nov.)**

(Pl. I, figs. 1—7)

**Description:** Cephalon convex. Rim broad, moderately convex; marginal furrow deep. Glabella conical, inconsiderably elevated above the cheek, rounded or slightly angulate in front. Anterior glabellar lobe small, about one-third the length of the glabella, separated from posterior lobe by a shallow, narrow and slightly curving backward or nearly straight transverse furrow. Median tubercle present, but not well preserved. Basal lobes very small, subtriangular. Cheeks smooth, separated in front by a well-defined preglabellar median furrow, strongly sloping down to the marginal furrow.

Pygidium subcircular in outline, strongly convex. Anterior margin almost straight in axial part and oblique backwards laterally. Axis very wide and long, elevated above the pleural lobes, occupying two-thirds the total breadth of the anterior portion of the pygidium, extending rearwards to the marginal furrow, divided into three lobes by two pairs of transverse furrows. First pair of furrows short, discontinuous; second pair rather long, meeting at the center, slightly oblique posterolaterally. First axial lobe very short, about one-eighth the length of the axial lobe; second lobe rather long, provided with a prominent elongate median tubercle. Posterior or third lobe very large, strongly expanded in the middle portion and rounded posteriorly. Dorsal furrow strong, subparallel in the anterior portion, diverging from the posterolaterally

corners of the second lobe and finally turning inwards and merged into the marginal furrow posteriorly. Marginal border of considerable width, convex, with a pair of short lateral spines. Marginal furrow deep and broad. Pleural plates very narrow, inclined strongly downwards laterally.

Two small pygidia and a small cephalon were figured in pl. I, figs. 19–20. Cephalon subcircular, convex; glabella conical, very acute in front; preglabellar median furrow distinct; glabellar anterior lobe small, subcircular; transverse furrow shallow, dorsal furrow well-marked; rim narrow. Axial lobe of pygidium very convex and extending to marginal border, posterior lobe of axis slightly expanded; dorsal furrow strong, approximately parallel, merged into the marginal furrow posteriorly; median tubercle convex; border wide, marginal furrow narrow. Two small pygidia may be compared with homologous stage of *H. taitzehoensis* Chu (sp. nov.), described in this paper, but they differ from the latter in the very convex, broad and long axial lobe, and in the dorsal furrow which merge into the marginal furrow posteriorly in the pygidium.

**Remarks:** At the first glance, this species looks like a *Pseudagnostus*. It resembles the latter genus especially in its pygidium, which has an unusual large axial lobe and the posterior portion of dorsal furrows is strongly oblique laterally. It appears difficult to distinguish the dorsal furrows of the pygidium of our species from the diagonal accessory furrows of *Pseudagnostus*, which are very short and straight, meeting the marginal furrow at the lateral sides of the pygidium. The dorsal furrows of our species are firstly oblique laterally from the posterolateral corners outwards, then turning inwards and backwards to confluent with the marginal furrow at the posterior end of the axial lobe.

*H. convexus* is closely similar to *H. lochmane* Howell and Duncan from *Cedaria* zone and *Crepicephalus* zone of Central Montana, U.S.A., but the cephalon of our species has a more remarkable longitudinal furrow in front of the glabella and a broader marginal border; the pygidium is characterized by a much larger axis with a longer posterior lobe, by the narrower marginal border and by the deeper and broader marginal furrow.

**Horizon and Locality:** *Blackwelderia paronai* zone, Erhtaokou, Yingtze of Penchi, Liaoning (BE126).

### ***Homagnostus taitzehoensis* Chu (sp. nov.)**

(Pl. I, figs. 8–19)

**Description:** Only flattened specimens in shale are present. Cephalon subcircular in outline, width and length subequal. Rim narrow, subequal in breadth, convex; marginal furrow shallow and gradually narrowing backwards. Glabella conical, pointed but not acutely in front, about one-third the width of cephalon. An-

terior glabellar lobe small, separated from the posterior portion by a shallow and slightly curving backward transverse furrow; posterior glabellar lobe with a pair of very faint lateral impressions at about anterior third and a very feeble median tubercle. Basal lobe moderate, triangular. Preglabellar median furrow very faint. Dorsal furrows distinct.

Pygidium subcircular in outline, width and length subequal. Rim narrow, almost uniform in breadth, convex, with a pair of very short and small marginal spines; marginal furrow shallow. Axial lobe broad, about two-thirds the width of pygidium, long but not extending to marginal furrow, divided transversely by two pairs of rudimentary lateral impressions into three lobes. First and second lobes equal in length; second lobe with a long, prominent median tubercle. Third lobe large, expanded in middle and more or less rounded posteriorly. Lateral lobe narrow than axis, confluent behind the axial lobe.

Surface smooth.

Figs. 7—15 on Pl. I form a series of growth stages.

The smallest specimen figured on pl. I, fig. 7 is a cephalon. Cephalon subquadrangular in outline, longer than wide, measuring about 0.46 mm in length and 0.40 mm in width. Glabella conical, pointed in front, preglabellar median furrow well-defined; anterior glabellar lobe very small, subtriangular, about one-fifth the length of glabella; rim narrow, marginal furrow distinct, median tubercle faint. Pl. I, fig. 8 is a cephalon in which the glabella is only slightly pointed in front, the preglabellar median furrow is also well-defined, but the anterior glabellar lobe is comparatively large, other features are similar to preceding stage; it is only 0.55 mm in length and 0.50 mm in width. Pl. I, fig. 9 shows a slightly advanced cephalon with the width and length subequal (0.80 mm). The glabella is conical in shape, slightly pointed but not acutely in front, anterior glabellar lobe less than one-third the length of glabella, preglabellar median furrow shallow, not well defined; rim very narrow. Pl. I, fig. 10 is a cephalon of adult stage. It cannot be distinguished from the larger specimen depicted on Pl. I, fig. 16 in spite of small size.

Fig. 11 on Pl. I is a smallest pygidium in the collections. It is subquadrangular in shape and measures about 0.60 mm long and 0.55 mm wide. Axial lobe elongated triangular in outline, pointed posteriorly; since the anterior portion was destroyed, the details are not known. Rim very broad, marginal furrow distinct. Pl. I, fig. 12, a pygidium with a length of 0.75 mm and width of 0.70 mm. Axial lobe conical, rounded in the rear end, with two transverse furrows in anterior portion and a median tubercle in the second axial lobe; marginal furrow well-defined. Rim broad, with a pair of small marginal spines on the postero-lateral sides. A more advanced stage is shown on Pl. I, fig. 13, the length and the width of this specimen are subequal, measuring 1.0 mm. The axial lobe is subcylindrical, slightly contracted at the middle and rounded in posterior end. Other characters are essentially similar to those of the preceding stage. Pl. I, fig. 14 is a larger specimen with a length of 1.60 mm and

width of 1.80 mm. The specimen is subcircular in outline. It differs chiefly from the preceding stage in the slightly expanded posterior lobe of the axis, in the narrower marginal rim and in the flattened and wider pleural lobes. Fig. 15 on Pl. I shows a pygidium in mature stage. It differs from the large specimens on Pl. I, figs. 17 and 18 only in the less expanded posterior lobe of the axis.

The major features in the development of the young individuals as well as the adult form mentioned above may be summarized briefly as follows:

1. The cephalon and pygidium in the earliest stage are subquadrangular in outline, longer than wide. They increase in width in succeeding stages and finally become subcircular in the adults.

2. The preglabellar median furrow of cephalon is well-defined in the smallest stage. It becomes fainter in the adults.

3. The glabella of the earliest stage is pointed in the front. It becomes less angulated in the adult stage.

4. The anterior lobe of glabella is very small and subtriangular in the youngest stage. It increases in its size in the progressive stages and finally becomes subcircular with fully grown curving transverse furrow in adult stage.

5. The axial lobe of pygidium is subtriangular in shape and pointed posteriorly in the first stage. In the later stages it becomes conical with rounded-angulated posterior end, then it becomes cylindrical with round end and finally the posterior lobe expands in the middle and becomes semi-globular in shape in adult stage.

6. The rim of pygidium in the earliest stage is very broad but it becomes narrower in the later stages and even more so in the adults.

**Remarks:** The cephalon of *H. taitzehoensis* differs from that of *H. hoi* (Sun) from the Changshan Formation of N. China in having a median tubercle located at posterior lobe in a slightly curving backward transverse furrow, in the fainter preglabellar median furrow and in the median sized basal lobe. The pygidium of our new species differs from *H. hoi* in the comparatively larger axial lobe and in the indistinct transverse furrow.

**Horizon and localities:** *Blackwelderia paronai* zone of Tangshihling, Yentai, Liaoning (BE438) and *Drepanura premesnili* zone of Erhtaokou, Yingtze, Penchi, Liaoning (BE121) and of Wutingshan, Yentai, Liaoning (BE410).

**Subgenus *Quadrahomagnostus* Chu (subgen. nov.)**

**Subgenotype:** *Homagnostus* (*Quadrahomagnostus*) *subquadratus* Chu  
(sp. nov.)

**Diagnosis:** Cephalon subquadrangular, constricted posteriorly. Rim narrow. Transverse furrow curved backwards. Anterior glabellar lobe very small, posterior glabellar lobe with a pair of very faint lateral impressions and with a very shallow and curving forwards furrow. Median tubercle small. Basal lobes moderate triangular. Preglabellar median furrow well-defined. Dorsal furrows distinct.

Pygidium subquadrangular, constricted anteriorly. Rim narrow, broad postero-laterally, with a pair of short and powerful marginal spines. Axial lobe large, posterior lobe semi-globular in shape.

**Remarks:** Howell established *Homagnostus* for the group of *Aagnostus pisiformis obesus* Belt. The outstanding features of this genus as remarked by Howell are as follows: "Aagnostids with well developed dorsal and transverse furrow, a smooth test, a bilobed glabella, which is somewhat but not acutely, pointed in front, a rather faint median furrow on the cephalon, and a large pygidial axis, whose rear lobe is more or less semi-globular in shape." *Quadrahomagnostus* agrees fairly well with *Homagnostus* in the well developed dorsal and transverse furrows, in a smooth test, in the shape of glabella, and in a large pygidial axis with a semi-globular rear lobe. The glabella of *Homagnostus* is somewhat pointed but not strongly acute in front. Our new subgenus is characterized chiefly by its subquadrangular shaped cephalon and pygidium, by a very small anterior glabellar lobe and by the peculiar glabellar furrows.

**Geological and geographical distribution:** Early Upper Cambrian, Kushan Formation of Taitzeho Valley, Liaoning.

***Homagnostus (Quadrahomagnostus) subquadratus* Chu(sp. nov.)**

(Pl. I, figs. 21—24)

**Description:** Cephalon subquadrangular, tapering posteriorly, moderately convex; rim convex, narrow, uniform in breadth; marginal furrow broad, shallowing and gradually narrowing backward. Glabella subconical, roundly angulated in front; anterior glabellar lobe very small, subcircular, separated from the posterior portion by a narrow and strongly curved transverse furrow; posterior glabellar lobe with a pair of very faint lateral impressions at about anterior third and with a very shallow and curving forwards furrow at about one-half of posterior portion, the furrow is almost indiscernible at the middle. Median tubercle small, located at the center of the posterior portion of the glabella. Basal lobe moderate, triangular. Preglabellar median furrow well-defined and direct connecting the frontal marginal furrow and glabella. Dorsal furrows distinct.

Thorax unknown.

Pygidium subquadrangular, constricted anteriorly; marginal furrow broad and well-defined; rim narrow, broad postero-laterally, convex with a pair of short and powerful marginal spines. Axial lobe broad and long, about two-thirds the width of the pygidium, elevated above the pleural lobes, extending posteriorly to the marginal furrow and divided by two pairs of transverse furrows into three lobes. Anterior pair of furrows deep on sides, shallowing and extending inwards and slightly forwards to the middle. First and second lobes subequal, wider than long. Second lobe provided with an elongated median tubercle sloping gently forwards to the anterior end and ending abruptly highly at the posterior



end. Third or posterior lobe large, about two-thirds the total length of the axis, expanded in the middle portion and rounded behind, marked by a longitudinal median ridge extending throughout the whole length. In a well preserved specimen (Pl. I, fig. 4) a row of four small elliptical nodes have been observed on each side of the longitudinal ridge, besides there are a pair of large muscular scars in front of the first pair of nodes. Pleural lobes convex, sloping downwards to the marginal furrow.

Surface smooth.

**Remarks:** On each side of the posterior lobe (third lobe) of pygidium there has a row of four small elliptical nodes as shown in Pl. I, fig. 4. A more or less similar feature is present in certain species of *Pseudagnostus*. Both the nodes or pits in these trilobites, in the writer's opinion, are actually muscular scars as shown in many groups of trilobites.

**Horizon and localities:** *Blackwelderia paronai* zone of Yaopu, east of Tienshihfu, Liaoning (BE876), *Drepanura premesnili* zone of Wutingshan of Yentai (BE410); and of Lotolingtze, Yingtze of Penchi, Liaoning (BE385, BE387).

***Homagnostus (Quadrahomagnostus) tienshihfuensis* Chu(sp. nov.)**

(Pl. I, figs. 25—26)

**Comparison:** This species differs principally from the subgenotype, *Q. subquadratus*, in the larger anterior glabellar lobe, in the less curved transverse furrow in glabella, and in the comparatively wide and short end lobe of axis in pygidium. The elliptical nodes in the posterior axial lobe of the pygidium of *H. subquadratus* are not present in our species, but a pair of large scars also occur in the anterior portion of the posterior lobe.

**Horizon and localities:** *Blackwelderia paronai* zone of Yaopu, east of Tienshihfu, Liaoning (BE876).

**Genus *Lotagnostus* Whitehouse 1936**

**Genotype:** *Aagnostus trisectus* Salter, 1864

***Lotagnostus* (?) sp.**

(Pl. I, fig. 20)

A small cephalon, subcircular in outline, convex, with a broad rim, followed by a deep and narrow furrow. Glabella convex, about three-fourths the length and about one-third the breadth of the cephalon, gradually tapering forwards, rounded in front; posterior lobe with a pair of shallow lateral furrows on both sides at about anterior third of the posterior lobe, and just behind them, a small median tubercle. Basal lobes small, triangular. Checks ornamented with very weak radiate furrows and separated by a well defined preglabellar median furrow.

The present form agrees fairly well with *Lotagnostus*, but differs in its small

anterior lobe of glabella, and in the small basal lobes and the broad rim. As only a single cephalon is known, it seems insufficient for a comparison with any particular species. The specimen is therefore mentioned under the name *Lotagnostus*(?) sp., pending the discovery of additional material that may clear up the relationship of this form.

**Horizon and locality:** *Blackwelderia paronai* zone of Erhtaokou, Yingtze of Penchi, Liaoning (BE126).

**Gen. et sp. indet. a**

(Pl. I, fig. 27)

Pygidium subquadrangular in outline, widening postero-laterally. Rim convex, with a pair of very small lateral spines. Axial lobe convex, long, but not reaching to the marginal furrow, subcylindrical in frontal portion and abruptly constricted to a pointed end posteriorly, faintly segmented into three lobes. First and second lobes short, subequal, second lobe provided with a pronounced median tubercle.

This pygidium is somewhat similar to that of *Doryagnostus* Kobayashi in some aspects, but it differs from the latter genus in having a subquadrangular outline, in the broad rim, in the position of median tubercle, which is located at the center of the axial lobe instead of being at the anterior portion of that genus. Moreover, the posterior lobe of the present form is not depressed as that of *Doryagnostus*.

**Horizon and locality:** *Blackwelderia paronai* zone of Tangshihling of Yentai, Liaoyang, Liaoning (BE451).

**Gen. et sp. indet. b**

(Pl. I, figs. 28, 29)

Several flattened pygidia are present in the material. It resembles *Peronopsis* in the general outline and in the presence of lateral spines, but differs from the typical forms of that genus in its narrower and more conical axial lobe and in the longer posterior lobe.

**Horizon and localities:** *Drepanura premesnili* zone, Wutingshan of Yentai Liaoyang, Liaoning (BE410) and Erhtaokou, Yingtze of Penchi, Liaoning (BE121).

**Superfamily Agrauloidae Hupé, 1953**

**Family Agraulidae Raymond, 1913**

**Genus *Tangshihlingia* Chu (gen. nov.)**

**Genotype:** *Tangshihlingia subtriangulata* Chu (sp. nov.)

**Diagnosis:** Small sized trilobite of low convexity, with subtriangular cranium and short truncato-conical glabella, without glabellar furrows. Dorsal furrows deep at the sides and almost imperceptible in front of the glabella. Brim nearly flat, or very slightly convex, converging anteriorly, a little shorter than the glabella and more or less angulated in front. Occipital ring of equal breadth.

Fixed cheek of median breadth. Palpebral lobe of moderate size, located fairly posteriorly. Anterior branches of facial sutures converging from the eyes to cut the anterior margin in a rounded curve; posterior branches very short, diverging from the eyes.

**Remarks:** *Tangshihlingia* may be a member of the family Agrauidae. It agrees fairly well with *Agraulos* Corda in the uniform occipital ring and in the undifferentiated border, but differs from the latter in having a truncato-conical glabella, in the subtriangular border, in the median sized palpebral lobe and in the low convexity of the shell. *Metagraulos* Kobayashi is also somewhat similar to our new genus, but the former has a convex glabella and the occipital ring is broad in the middle or produced back into a spine. *Bynumia* Walcott from the Upper Cambrian of North America resembles *Tangshihlingia* in the triangular cranidium and in truncato-conical glabella, but the America form is easily distinguished by the position of the palpebral lobe which is located at the midlength of cranidium and the dorsal furrows are rather weak on both sides of the glabella.

**Geological and geographical distribution:** *Blackwelderia paronai* zone, Taizhe Valley Liaoning.

***Tangshihlingia subtriangulata* Chu (sp. nov.)**

(Pl. I. figs. 30, 31)

**Description:** Cranidium subtriangular in outline, small, usually less than 1.5 mm in length and 2.0 mm in basal width. Glabella truncato-conical, moderately convex, flattened anteriorly, indistinctly defined from the border. No traces of glabellar furrows. Dorsal furrows deep and wide in posterior portion, shallowing forwards and almost indiscernible in front of the glabella. Border flat, angulate in front. Occipital furrow transverse, well-defined; occipital ring slightly convex, uniform in breadth in central portion, narrowing very gradually towards both sides. Palpebral lobe medium-sized, situated behind the midlength of the glabella. No ocular ridge. Fixed cheek slightly convex, about two-thirds the width of the glabella at the base. Posterior border narrow, postero-marginal furrow deep and narrow. Anterior branches of facial sutures converging from eyes forwards, cutting the frontal margin in a gently curve; posterior branches short, running from the posterior end of the eyes slightly outwards and backwards.

Surface smooth.

Thorax and pygidium unknown.

**Horizon and Locality:** *Blackwelderia paronai* zone, Tangshihling of Yentai, Liaoyang, Liaoning (BE 438, BE 451).

**Superfamily Utioidae Hupe, 1953****Family Liostracinidae Raymond, 1937****Genus *Liostracina* Monke, 1903****Genotype: *Liostracina krausei* Monke, 1903*****Liostracina krausei* Monke, 1903**

(Pl. I, figs. 30—32)

1903. *Liostracina krausei* Monke, Obercambrische trilobiten von Yen-Try-Yai, p.114, pl. 3, figs. 10—17.  
 1905. *Ptychoparia ceus* Walcott, Proc. U.S.Nat. Mus. Vol. 29, p. 76.  
 1913. *Liostracina krausei* Walcott, Research in China, Vol. 3, p. 143, pl. 11, fig. 8; pl. 14, figs. 2, 2a.  
 1935. *Liostracina krausei* Kobayashi, Journ. Fac. Sci. Imp. Univ. Tokyo, Sect. 2, Vol. 4, pt. 2, p. 254, pl. XII, fig. 6; pl. XIII, fig. 9.  
 1937. *Liostracina krausei* Endo et Resser, Manchurian Sci. Mus. Bull. 1, p. 238, pl. LI, figs. 11, 12.

This species is characterized by a small, conical glabella, with rounded front, by the slightly convex brim with a longitudinal furrow which is extending from the front of the glabella to marginal furrow, by the slightly upturned border and by a pair of small and convex side lobes which is located at the postero-lateral angle of glabella.

Pygidium short, broader than long, with uniform, narrow and convex border; posterior marginal furrow narrow and deep. Axial lobe tapering gradually backwards and rounded at its terminal extremity, divided by narrow and distinct furrows into 4—5 axial segments and an end lobe. Pleural lobe broad, subtriangular, with 4—5 pairs of very narrow pleural furrows. Anterior margin straight. Pointed laterally. Surface smooth.

**Horizon and Localities:** *Drepanura premesnili* zone, Chiawang, northern Kiangsu; Kushan of Shantung, and Tangshihling and Wutingshan, Yentai of Liaoyang, Liaoning.

**Family Utiadae Kobayashi 1935****Genus *Lorenzella* Kobayashi 1935****Genotype: *Agraulos abaris* Walcott*****Lorenzella parabola* Lu 1957**

(Pl. I, fig. 35; Pl. II, figs. 1—5)

1957. *Lorenzella parabola* Lu. "Trilobites", in Index Fossil of China, p. 272, pl. 142, fig. 14.

**Description:** Cephalon semi-circular in outline, convex; dorsal furrows very deep and wide. Glabella strong convex from side to side, gently convex from back to front, truncato-conical, with three pairs of oblique glabellar furrows: anterior pair very short, only faintly impressed on the sides, second pair deeper and wider, posterior pair rather long, running from the dorsal furrow directly inwards and slightly backwards. Brim very convex, comparatively broad, raised in front of the glabella to form a boss and with a pair of grooves which run obliquely forwards from the antero-lateral corners of the glabella disappearing until they reach to the frontal margin. Occipital furrow

distinct, nearly straight or slightly arched forwards at the middle. Occipital ring semi-circular, expanded towards the axial line, narrowing laterally, strong convex and provided with a small median node. Palpebral lobe medium sized, located at the midlength of the glabella; ocular ridge well defined, extending from the dorsal furrow opposite to the first glabella furrows almost horizontally outwards, and then curving gradually backwards and outwards to connect with the palpebral lobe. Fixed cheek about two-thirds as wide as the glabella at the base, very convex, inclined almost perpendicular to dorsal furrows. Posterior marginal furrow shallow, wide, straight in the rear part and bending forwards laterally; posterior margin border wide at the middle. Free cheek small, nearly flat, narrow in front; lateral marginal border of moderate width, ornamented with a row of eight small nodes. Genal spine very short, directed laterally and slightly posteriorly. Anterior branches of the facial sutures running from the palpebral lobes outwards and then curving forwards and inwards to cut the anterolateral margin in a rounded curve; posterior branches short, extending slightly oblique backwards and cutting the lateral margin just behind the genal angle.

Pygidium subfusiform, about two times as wide as long. Axis convex, conical, tapering regularly backwards and extending to the marginal border, faintly segmented into 5–6 rings. Pleural lobes subtriangular, pointed laterally, gently convex, with a pair of deep anterior furrow and four pairs of thread-like, ridged lines. Marginal border narrow and convex, marginal furrow well defined.

Surface smooth.

**Remarks:** This species is closely related to *L. (?) ogurai* Endo et R  sser, but it differs from the latter in having well-defined glabellar furrows and in the relatively more swollen fixed cheeks and brim. Another allied species is *L. quadrata* Kobayashi which differs from our species in the subquadrate cranidium, in the unfurrowed glabella, in the absence of nodes on the marginal border of free cheek, in the semi-ovate pygidium with shorter axial lobe, in the sinuated posterior margin and in the absence of marginal border.

There are two types of pygidia hitherto referred to *Lorenzella*: one type has no marginal spines as in the species *L. parabola* Lu described above and *L. quadrata* Kobayashi from the *Drepanura* zone of Shoku-do and Kasetzu-ji of Southern Korea; another type has several pairs of marginal spines such as *L. rotundata* Endo et R  sser from the Middle Cambrian, Taitze Formation, Sao-miao-tzu of eastern Liaotung. It is uncertain which type of pygidia belongs to *Lorenzella* when the complete dorsal shield is not known.

**Horizon and localities:** *Blackwelderia paronai* zone; from the following three localities: (1) Lotolingtze, north of Yingtze, Penchi, Liaoning (BE387), (2) Erhtaokou, Yingtze of Penchi, Liaoning (BE125, BE126), and (3) Chiawang coal field, northern Kiangsu (Ls50, Ls51, Ls55).

***Lorenzella pustulosa* Chu (sp. nov.)**

(Pl. II, figs. 6—8)

**Description:** Cranidium small, semi-ovate in outline. Glabella strong, convex, elevated above the cheeks, truncato-conical, with one pair of very weak, oblique glabellar furrows. Dorsal furrows very strong. Brim convex, trilobited into three parts by a pair of oblique furrows diverged from the anterolateral corners of the glabella to the frontal margin. Occipital ring expanded towards the axial line; occipital furrow straight. Ocular ridge obsolete. Fixed cheek a little wider than the glabella, convex, as high as brim. Facial sutures convergent anteriorly.

Surface ornamented with pustules.

**Remarks:** This species is easily distinguished from *L. (?) convexa* Endo et Resser by its small cranidium, less swollen brim and fixed cheeks and by the presence of large punctae on the surface.

**Horizon and locality:** *Drepanura presmesnili* zone; Tangshihling; Yentai of Liaoyang Liaoning (BE449).

***Lorenzella subcylindrica* Chu (sp. nov.)**

(Pl. II, figs. 11—13)

**Description:** Glabella convex, subcylindrical or very slightly tapering anteriorly; with three pairs of short, faintly impressed oblique glabellar furrows. Dorsal furrows deep and broad. Brim convex, raising into a low boss in front of the glabella, angulated anteriorly to form a broad, obtuse angle. Occipital ring semicircular, with a small median node at the center. Palpebral lobe medium sized, situated posteriorly; ocular ridge well defined. Fixed cheek moderately convex, narrow, about one-half the width of glabella at the base.

Pygidium subfusiform; axial lobe convex, conical, tapering backwards, rounded in rear and extending to the marginal border, faintly segmented into 5—6 rings. Pleural lobes with a pair of deep anterior furrow and four pairs of thread-like, convex, ridged lines. Marginal border narrow and convex, marginal furrow indistinct.

**Remarks:** This species resembles *L. tatei* (Woodward) from the Middle Cambrian (Parara limestone) of Curramulka, South Australia in its angulated brim, but its narrow fixed cheek, the deep and broad dorsal furrows, and the presence of a pair of oblique grooves extending from the antero-lateral corners of the glabella across the brim serve to distinguish it from the Australian species.

**Horizon and locality:** *Blackwelderia paronai* zone, at Yaopu, east of Tien-shihfu, Penchi district of Liaoning (BE876).

***Lorenzella yentaiensis* Chu (sp. nov.)**

(Pl. II, figs. 9—10)

**Comparison:** This species in some respects resembles *L. paraloba* Lu from the

same formation. The relatively less swollen brim and fixed cheeks, the smaller size, the longer glabella and the wider fixed cheeks are characteristic features of this species.

**Horizon and locality:** *Blackwelderia paronai* zone, Tangshihling, Yentai of Liaoyang, Liaoning (BE451).

***Lorenzella kushanensis* Chu (sp. nov.)**

(Pl. II, figs. 14—15)

**Comparison:** The present form is closely allied to *L. parabola* Lu, but differs from the latter in having a longer glabella, a less swollen brim and fixed cheeks, and more prominent ocular ridge.

**Horizon and locality:** *Blackwelderia paronai* zone, Tangwangchai of Kushan, Shantung (BW36).

***Lorenzella(?) convexa* Endo et Resser 1937**

(Pl. II, fig. 16)

1937 *Lorenzella(?) convexa* Endo et Resser, Manchurian Sci. Mus. Bull. 1, p. 233, Pl. LV, figs. 18—19; Pl. LIV, figs. 26—27.

The present specimen agrees fairly well with the types in the outline of cranium, in the tumid brim and in the punctate surface ornamentation. Our specimen which is found in shale is more flattened than the types which is preserved in limestone.

**Horizon and locality:** *Drepanura premesnili* zone, Wutingshan, Yentai of Liaoyang, Liaoning (BE409).

**Superfamily Olenoidae Hupé, 1953**

**Family Damesellidae Kobayashi 1935**

**Subfamily Dorypygellinae Kobayashi 1941**

**Genus *Teinistion* Monke, 1903**

**Genotype: *Teinistion lansi* Monke, 1903**

***Teinistion yangi* Chu (sp. nov.)**

(Pl. II, figs. 17—23)

**Description:** Glabella convex, truncato-conical, nearly straight in front. Two pairs of discontinuous glabellar furrows present; posterior pair long, strongly oblique backwards; anterior ones very weak, slightly impressed on both sides of glabella. Brim very narrow and concave; border narrow at sides rather broad in the middle portion, inclined inwards to the marginal furrow which extends obliquely towards the antero-lateral corners of the cranium. Anterior margin slightly curving backwards at the middle. Occipital furrow transverse, well-defined; occipital ring uniform in breadth. Palpebral lobe medium sized, located posteriorly; ocular ridge strong, extending outwards and backwards from antero-lateral corners of the glabella to the palpebral lobe. Fixed cheeks slightly convex, as broad as the glabella at the base, with a pair of large semicircular lobes on the lateral sides of the glabellar rear

part. Posterior limb narrow elongated subtriangular; posterior border narrow, uniform in breadth; posterior marginal furrow deep. Anterior branches of facial sutures slightly diverging from the palpebral lobes forwards, then running inwards to cut the anterior margin in a strong curve, posterior branches extending strong outwards in a line nearly parallel to posterior margin, then abruptly turning backwards to cut the posterior margin at a distance from the dorsal furrows equal to two times of the basal width of glabella. Free cheeks roughly subtriangular in shape, gently convex. Lateral border narrowing anteriorly, widening rearwards and producing into a long and large genal spine.

Pygidium subsemicircular, about two times as wide as long. Axis conical, narrow, tapering gradually backwards and connecting with the posterior border by a narrow ridge, slightly elevated above the pleural lobes, with 6 rings separated by well-defined transverse furrows. Pleural lobes subtriangular, flat, with 5—6 pairs of broad and concave pleural furrows and faintly defined interpleural grooves. Border well-defined. Six pairs of marginal spines present, first pair longer and larger, producing directly from the first pleural segment obliquely.

Surface smooth.

**Remarks:** The new species is similar to the genotype, *T. lansi* Monke but differs from the latter in having a truncato-conical glabella, in the slightly backwards curved frontal margin and in the presence of a pair semicircular lobes at the sides of dorsal furrows instead of having two pairs of strong folds in the latter species.

Another allied species is *T. truncatus* Endo, which simply differs from our form in a broader brim and in the absence of the side lobes on the fixed cheeks.

**Horizons and Localities:** *Blackwelderia paronai* zone; from (1) Tangshihling, Yentai of Liaoyang, Liaoning (BE451, BE438), (2) Erhtaokou, Yingtze of Penchi, Liaoning (BE126); *Drepanura premesnili* zone of Wutingshan, Yentai of Liaoyang, Liaoning (BE410).

***Teinistion tangshihlingensis* Chu (sp. nov.)**

(Pl. II, figs. 24—25)

**Description:** Glabella relatively broad, truncato-conical, moderately convex. Glabellar furrows not well defined. Border slightly projected backwards at the middle, narrowing gradually laterally, slightly upturned. Anterior margin almost straight. Fixed cheeks comparatively narrow, with a pair of small semi-circular side lobes (these lobes become oblique folds probably due to longitudinal compression as shown on Pl. II, fig. 20). Ocular ridge weak, palpebral lobe fairly back.

**Remarks:** This species differs from *T. yangi* in the broad glabella, in the broader border, in the straight anterior margin and in the comparatively narrow fixed cheeks.

**Horizon and Localities:** *Blackwelderia paronai* zone, Tangshihling, Yentai of Liaoyang, Liaoning (BE451, BE438).



***Tinistion liaoningensis* Chu (sp. nov.)**

(Pl. II, figs. 26—27)

This species is determined based on two somewhat fragmental cranidia. The characteristic features of the cranidia are sufficiently well defined to warrant a generic and specific name.

**Comparison:** This species is distinguished from *T. yangi* by its nearly cylindrical glabella and very wide fixed cheeks. It differs from *T. tangshihlingensis* in the wide fixed cheeks and in the curved anterior margin.

**Horizon and localities:** *Blackwelderia paronai* zone; Tangshihling, Yentai of Liaoyang, Liaoning (BE451).

**Genus *Dorypygella* Walcott, 1905****Genotype: *Dorypygella typicalis* Walcott, 1905*****Dorypygella hsihsienensis* Chu (sp. nov.)**

(Pl. II, fig. 28; Pl. III, fig. 1)

**Description:** Glabella convex, elongate conical, rounded in front; glabellar furrows obscure. Border narrow and upturned, marginal furrow deep, frontal margin straight. Occipital furrow shallow, slightly bending backwards in middle; occipital ring uniform in breadth throughout. Ocular ridges prominent oblique. Fixed cheeks of medium breadth, about two-thirds the width of the glabella at the base, sloping obliquely down to the dorsal furrows, with a pair of small, oval side lobes closed to the dorsal furrows. Anterior branches of facial sutures unknown; posterior branches directing obliquely outwards and slightly backwards, then bending backwards to cut the posterior margin at a distance from the dorsal furrows equal to one and half times the basal width of glabella.

Surface smooth.

**Remarks:** The present species is very similar to *Dorypygella typicalis* Walcott, but it differs from the latter in having comparatively narrow fixed cheeks, in the wider posterior marginal border, in the absence of glabellar furrows. It differs from *D. alcon* Walcott in the larger glabella without glabellar furrows, in the wider fixed cheeks and in the prominent ocular ridges.

**Horizon and localities:** Early Upper Cambrian, Kushan Formation; Hsihsien, Shansi (Sk18).

**Genus *Drepanura* Bergeron, 1899****Genotype: *Drepanura premesnili* Bergeron, 1899*****Drepanura transversa* Chu (sp. nov.)**

(Pl. III, figs. 2—3)

**Description:** Pygidium broadly semi-elliptical in outline exclusive of the mar-

ginal spines, about twice as wide as long. Axis subcylindrical, with a rounded end, convex, elevated above the pleural lobes, divided into three to four unequal rings in addition to an articulating half-ring and a terminal lobe. Pleural lobes subtriangular: anterior portion separated into three deep pleural furrows which run directly outwards and slightly backwards and die out inside the border, posterior portion entire. First pleura large, projected divergently backwards into a gently convex, short, falcate spine. Between the lateral spines there are six pairs of short spines among which the outer four pairs longer than the inner ones. Surface ornamented with very few postules.

**Remarks:** This species is characterized by the less oblique pleural furrows and very broad outline of pygidium. It differs from *D. premesnili* Bergeron in the longer and subcylindrical axial lobe and in the longer pointed spines between the first pair of spines. From *D. ketteleri* Monke, it distinguishes by relatively narrower and strongly divergent first lateral spine. It agrees with *D. eremita* Westergard from the *Agnostus pisiformis* zone of Sweden in the subcylindrical and longer axis and in the comparatively well defined border with peculiarly pointed spines. *D. transversa* is distinguished from the Swedish form by the semi-elliptical instead of being a subtriangular outline, by a fewer number of segments, by the relatively broad axis and by the longer marginal spines.

**Horizon and Locality:** *Drepanura premesnili* zone; Chiawang coal field, northern Kiangsu (Ls 56).

### Genus *Shantungia* Walcott 1905

#### Subgenus *Parashantungia* Chu (subgen. nov.)

#### Subgenotype: *Parashantungia elongata* Chu (sp. nov.)

The new subgenus is similar to *Shantungia*, but the glabella is elongate rectangular in shape. The frontal border is much shorter and the fixed cheek is usually not so wide as that of *Shantungia*. Further observations will be found in the description of the subgenotype.

**Geological and geographical distribution:** *Drepanura premesnili* zone; of Taitzeho valley, Liaoning.

#### *Parashantungia elongata* Chu (sp. nov.)

(Pl. III, figs. 4—5)

**Description:** Glabella large, elongate rectangular, more than two-thirds the length of cranidium excluding the frontal spine, convex from side to side, sloping forwards in front. Glabella furrows obsolete. Frontal border short, slightly convex, angulate in front and extending forwards at the center into a long, slender, rounded spine. Antero-marginal furrow deep at the sides, shallowing and arching slightly backwards at the central portion; brim very short and scarcely separable from the

downwards slope of the front of the glabella. Occipital ring gently convex, uniform in breadth from side to side; occipital furrow straight, deep at the sides, rather shallow near the center. Dorsal furrows deep in both sides of the glabella, almost indiscernible in front. Fixed cheek a little narrower than the glabella, convex, rising steeply from the dorsal furrows and sloping slightly upwards to the palpebral lobe. Palpebral lobe large, bow-shaped, situated behind the midlength of glabella. Ocular ridge weak. Posterior limb transversely subtriangular, extending about equal width of the glabella outwards from the dorsal furrows. Postero-marginal furrow shallow and wide. Anterior branches of facial sutures running slightly convergent forwards to cut the border in a rounded angle; posterior branches diagonal.

**Remarks:** A cranidium referred to *Shantungia spinifera* by Resser and Endo (1937, Pl. L, fig. 15) is identical with the present species, but the truncato-conical glabella is more like that of *spinifera* than that of *elongata*.

**Horizon and locality:** *Drepanura premesnili* zone: Wutingshan, Yentai of Liaoyang, Liaoning (BE410).

#### **Subgenus *Metashantungia* Chang, 1957**

#### **Subgenotype: *Shantungia brevica* Walcott, 1913**

This subgenus is allied to *Shantungia* Walcott on the one hand and to *Parashantungia* Chu (subgen. nov.) on the other. Comparison with both forms reveals that this subgenus has a broader cranidium, i.e. its glabella and fixed cheeks are relatively broader. It differs also from *Shantungia* in having a short frontal border and short frontal spine and in the course of the facial sutures. From *Parashantungia*, it is also easily distinguished by its truncato-conical glabella, short front spine and by the anterior facial sutures.

**Geological and geographical distribution:** *Drepanura premesnili* zone of Shantung.

#### ***Metashantungia brevica* Chang, 1957**

(Pl. III, figs. 6—7)

1913. *Shantungia spinifera* Walcott, Research in China, Vol. 3, p. 148, pl. 14, fig. 6 only.

1957. *Metashantungia brevica* Chang, Acta Palaeont. Sinica, Vol. 1, p. 31, pl. 1, fig. 6.

**Description:** Cranidium transverse, nearly twice as wide as long. Glabella convex, truncato-conical, a little longer than the width at the base. Glabellar furrow obsolete. Dorsal furrows very deep at the sides, rather shallow in front of the glabella. Border short, subtriangular, slightly convex, extending forwards at the center to form the base of a short, small spine, marginal furrow straight, deeply incised. Occipital furrow shallow and straight; occipital ring slightly arching backwards at the center. Fixed cheek convex, about one-half as wide as the glabella at the base, strongly sloping down to the dorsal furrows. Palpebral lobe large, slightly elevated above the fixed cheek, located at the back of the midline of cranidium. Ocular ridge

indistinct. Posterior marginal furrow shallow; posterior marginal border slender, extending more than the width of the glabella outwards from the dorsal furrows. Anterior branches of facial sutures running from the palpebral lobe slightly outwards then curving strongly inwards to cut the frontal margin; posterior branches passing strongly outwards and slightly backwards to cut the posterior margin well within the genal angle.

Surface smooth.

**Horizon and Locality:** *Drepanura premesnili* zone; Tangwangchai of Kushan (BW37) and Neuliutsuan, Sintai, Shantung (I71).

**Superfamily Olenoidae Hupe, 1953**

**Family Damesellidae Kobayashi, 1935**

**Subfamily Damesellinae Kobayashi, 1935**

**Genus *Taitzeoia* Chu (gen. nov.)**

**Genotype: *Taitzeoia wangi* Chu (sp. nov.)**

**Diagnosis:** Cranidium subtrapezoidal in outline. Glabella broad and long, truncato-conical, extending to border, with two pairs of oblique glabellar furrows. Dorsal furrows strong. Brim absent; border narrow and flat, frontal margin straight. Occipital ring uniform in breadth. Fixed cheeks narrow, less than the width of the glabella. Palpebral lobe median sized, situated in a position opposite the middle of the glabella, ocular ridge weak. Facial sutures nearly parallel anteriorly and oblique posteriorly. Free cheeks provide with very short, bifurcated genal spines.

Pygidium transversely semicircular in outline. Axial conical, slightly convex, divided by transverse furrow into 4 rings and a pointed terminal lobe. Pleural lobe with 5–6 segments. Marginal border narrow and well-marked, with six pairs of spines.

**Remarks:** This new genus is more similar to *Stephanocare* Monke and *Damesella* Walcott than to any other genera of the subfamily Damesellinae in the absence of a concave brim. It differs from *Stephanocare* and *Damesella* in the smooth surface and in the narrower fixed cheeks. Furthermore, the cephalon of *Stephanocare* has relatively large palpebral lobe and spinose margins, the pygidium has no indication of a border and the anchylosed segments extend directly across the border in the falcate spinose ends. *Damesella* is characterized by the broad cephalon, by the thick marginal border and by the pygidial axis which is rounded at the hind part instead of being angulate as in our new genus.

*Taitzeoia* may also be compared with *Blackwelderia* Walcott, but it differs in having a broad border, in the absence of a concave brim, in the very narrow fixed cheeks and in the comparatively broad glabella.

**Geological and Geographical Distribution:** *Drepanura premesnili* zone, Early Upper Cambrian Kushan Formation, Taitzeo Valley, Liaoning.

***Taitzehoia wangi* Chu (sp. nov.)**

(Pl. III, figs. 8—13)

**Description:** Glabella slightly convex, truncato-conical, a little longer than wide at the base, almost straight in front, but more or less rounded at the anterolateral corners, extending to border. Two pairs of oblique glabellar furrows; posterior pair long, deep, extending from the dorsal furrows obliquely backwards and inwards nearly the occipital furrow, anterior pair short but distinct. Dorsal furrows strong. Brim absent, border narrow and slightly convex, frontal margin straight. Occipital furrow rounded, well defined, and somewhat arcuate with backwards curvature; occipital ring gently convex, uniform in breadth, with a small median tubercle at the center. Palpebral lobes medium sized, situated opposite the middle of the glabella; ocular ridge short, weakly defined, extending outward opposite the first glabellar furrows horizontally outwards. Fixed cheeks gently convex, narrow, about one-third as wide as the glabella at the base. Posterior marginal border well-marked from the posterior limb by a deep and wide marginal furrow, narrowing gradually towards the occipital ring. Anterior branches of facial sutures extending very slightly divergent from eyes forwards, then turning abruptly inwards at a short distance from the frontal margin to cut the frontal border in a strong oblique curve; posterior branches running obliquely outwards and slightly backwards to cut the posterior border at a distance from the dorsal furrow about equal to the basal glabellar width. Free cheeks provided with well-defined marginal border and very short, bifurcated genal spines.

The associated pygidium is semicircular in outline. Axis slightly convex, conical, extending to marginal furrow, less than one-third the total breadth of the pygidium in front, narrowing gradually rearwards to a pointed terminal lobe, with 5 rings separated by well-defined transverse furrows. Pleural lobes subtriangular, divided by 4—5 pairs of slightly oblique pleural furrows. Interpleural grooves prominent, subparallel to the pleural furrows. Marginal border narrow but well-defined. The border projected to form six pairs of long spines, the sixth pair shorter than the others.

Surface smooth.

**Horizon and Localities:** *Drepanura premesnili* zone; Erhtaokou, Yingtze of Penchi (BE121) and Wutingshan, Yentai of Liaoyang, Liaoning (BE410).

***Taitzehoia erhtaskouensis* Chu (sp. nov.)**

(Pl. III, fig. 14)

**Comparison:** This species differs from the genotype, *T. wangi*, in the wider cranidium and in the comparatively broad and short glabella.

**Horizon and Localities:** *Drepanura premesnili* zone; Erhtaokou, Yingtze of Penchi (BE121), and Wutingshan, Yentai of Liaoyang, Liaoning (BE410).

**Genus *Blackwelderia* Walcott, 1906****Genotype: *Calymene? sinensis* Bergeron, 1900*****Blackwelderia mui* Chu (sp. nov.)**

(Pl. III, fig. 15)

**Description:** Glabella convex, truncato-conical, rounded in front, marked by three pairs of discontinuous glabellar furrows: posterior pair strongest, deep and long, extending obliquely inwards and backwards; second pair short, less oblique, anterior pair faintly marked. Dorsal furrows deep and wide. Brim broad and flat, slightly upturned. Frontal border very narrow, slightly convex; frontal margin rounded, arching forwards. Occipital furrow broad and slightly arching forwards in the middle, narrowing and deepening laterally. Occipital ring nearly uniform in width, provided with a small node. Palpebral lobes medium size, elevated, located at the midlength of glabella; ocular ridges faintly marked, extending slightly oblique backwards. Fixed cheeks less than one-half the width of glabella at the base, convex from back to front and sloping down to the dorsal furrows. Posterior marginal furrow deep and broad; posterior border narrow, slightly widening towards both sides. Anterior branches of facial sutures subparallel, cutting the frontal margin in a rounded curve; posterior branches diagonal.

Surface marked by numerous finely granules and scattered large pustules.

**Remarks:** The rounded frontal margin of this species is similar to that of *B. paronai* (Airaghi), but the brim is narrower and flatter, the glabella is wider and less convex, the surface is ornamented with fine granules and large pustules and the anterior branches of facial sutures are parallel to each other instead of being divergent forwards.

*B. mui* is also somewhat similar to *B. tieni* Sun, but it differs in having a broad and flat brim, in the narrow and slightly convex border. Moreover, the anterior branches of facial sutures cut the frontal margin in a rounded curve, whereas the anterior branches of facial sutures of *B. tieni* are almost perpendicular to the frontal margin.

**Horizon and Locality:** *Blackwelderia paronai* zone, Yaopu, east of Tien-shih-fu, Penchi, Liaoning (BE876).

***Blackwelderia paronai* (Airaghi) var. *penchiensis* Chu (var. nov.)**

(Pl. IV, figs. 7-10)

This new variety differs from the typical form in having a comparatively flat brim, in the narrow and less upturned frontal border and in the straighter frontal margin. Moreover, the facial sutures are approximately parallel to each other instead of being divergent forwards from the eyes, and the pygidial axis is relatively narrow and less rounded in the posterior end.

**Horizon and Localities:** *Blackwelderia paronai* zone; Tangshihling, Yentai of Liaoyang, Liaoning (BE448), Lotolingtze, north of Yingtze, Penchi, Liaoning (BE387).

***Blackwelderia liaoningensis* Chu (sp. nov.)**

(Pl. IV, fig. 1)

**Description:** Glabella convex, truncato-conical, a little longer than wide at the base, with three pairs of glabellar furrows: anterior pair very weak, second pair short, deep, running slightly oblique backwards and inwards, posterior ones divided into two branches at a short distances from the dorsal furrows, anterior branches rather short and weak, horizontal; posterior branches long, extending strong oblique backwards. Brim broad and concave; border narrow and upturned, frontal margin straight. Occipital furrow broad, curving backwards and deepening towards both sides; occipital ring rounded. Dorsal furrows very deep and broad. Ocular ridge obsolete.

Surface with finely granules on the occipital ring and with large pustules on the glabella and fixed cheeks.

**Remarks:** This species agrees with *B. sinensis* (Bergeron) in its straight frontal margin, in the shape of occipital ring and in the course of facial sutures, but the fixed cheeks of our form are certainly much narrower and the third glabellar furrow on each side bifurcates into two branches.

**Horizon and locality:** *Drepanura premesnili* zone: Erhtaokou, Yingtze of Penchi, Liaoning (BE123).

***Blackwelderia shengi* Chu (sp. nov.)**

(Pl. IV, figs. 2—6)

**Description:** Glabella convex, elongate truncato-conical, marked by two pairs of deep glabellar furrows: posterior pair very long, extending strongly oblique backwards to the occipital furrow, anterior pair very short. Dorsal furrows rather shallow, but well-defined. Brim slightly concave, as long as the border along the axis, defined by three crescentic arcs behind; border moderately convex, with straight margin. Occipital furrow straight in the middle, bending abruptly forwards at both sides. Occipital ring uniform in breadth. Palpebral lobes medium sized, located at the midline of the cranidium; ocular ridges obscure. Fixed cheeks flat, narrow, less than one-half the basal width of the glabella. Posterior marginal furrows broad and deep; posterior limbs subtriangular. Anterior branches of facial sutures parallel to each other at one-third their length, then bending obliquely inwards to cut the frontal margin at an obtuse angle; posterior branches directed obliquely outwards and backwards, cutting the posterior margin from the dorsal furrows at a distance equal to the basal width of glabella

Pygidium exclusive of spines triangular. Axis conical, rounded at the hind part, composed of five rings and a terminal segment. Pleural lobe divided into five ribs by deep and broad pleural furrows. Interpleural grooves well-marked. Border very narrow, with seven pairs of marginal spines, subcircular in cross-section.

Surface of both cranidium and pygidium crowded with numerous pustules of different sizes.

**Remarks:** *B. shengi* is related to *B. sinensis* (Bergeron) in several points, i.e. the straight frontal margin, the elongate truncato-conical glabella and the granular surface. Our form has more narrow fixed cheeks, shorter posterior border without large tubercles along the posterior margin. The pygidium of our form has more clearly defined interpleural grooves and the outline of the pygidium is subtriangular instead of semicircular in that species.

This species differs from *B. liaoningensis* Chu (sp. nov.) in having a shorter brim and in the quite different surface ornamentation of the test.

**Horizon and Locality:** *Drepanura* premesnili zone; Erhtaokou, Yingtze of Penchi, Liaoning (BE121, BE122).

### *Blackwelderia triangularis* Chu (sp. nov.)

(Pl. IV, figs. 11—12)

**Description:** *Pygidium* subtriangular in shape, with a ratio of the length to the width about 3:5, exclusive of the marginal spine. Axial lobe comparatively narrow, elongate conical, strongly convex, consisting of about 5—6 rings and a pointed end lobe. Pleural lobe subtriangular, moderately convex, divided by furrows into 6—7 ribs which are almost flat-topped; interpleural grooves obsolete; pleural furrows deep, relatively narrow, dying out on the border; the pleural ribs projected back into seven pairs of flat spines of about equal in length, but the seventh pair of spines is shorter in the smaller pygidium (Pl. IV fig. 12). Border wide and flat.

**Remarks:** Only three pygidia are known in the collection of Honan. The most closely related species is *Blackwelderia sinensis* (Bergeron) from which it differs in the less wide outline, narrower pleural furrows and broader border. It agrees with *B. shengi* Chu (sp. nov.) in the triangular outline of the pygidium, but the latter species has a broader axial lobe, very broad and less oblique pleural furrows, and a very narrow border.

**Horizon and Locality:** Kushan Formation of Mayao, Linju district, Central Western Honan (B3019).

### *Blackwelderia chiawangensis* Chu (sp. nov.)

(Pl. V, fig. 1)

**Description:** *Pygidium* exclusive of spines subtriangular in outline. Axial lobe



convex, subconical, composed of five rings and a rounded terminal lobe. Pleural lobe moderately convex, divided by deep and broad furrows into six ribs which decrease in size successively backwards. Border well defined, narrow, with seven pairs of divergent marginal spines, among them the sixth pair are longer and larger and the seventh one shortest. Posterior margin between the seventh spines straight and broad, about two-thirds the width of the axial lobe in front.

Surface ornamented with scattered pustules.

**Remarks:** It is closely similar to *B. spectabilis* Endo et Resser, but it differs from the latter species in the comparatively broad axial lobe, in the broad and straighter posterior margin between the last spines and in the pustulous surface. Kobayashi has erected a new generic name *Parablackwelderia* for the species *B. spectabilis*. Our species resembles also *B. paronai* (Airaghi), but the pleural lobe of the latter is narrower, and the marginal spines extend nearly directly backwards instead of being divergent posteriorly as in our species and the surface is smooth.

**Horizon and locality:** *Drepanura prmesnili* zone(?); Chiawang coal-field, northern Kiangsu (Ls68).

***Blackwelderia* cf. *octaspina* (Kobayashi)**

(Pl. IV, fig. 13)

1935. *Damesella octaspina* Kobayashi, Journ. Fac. Sci. Imp. Univ. Tokyo, Sect.2, vol.4, pt.2, p.170, pl.9 figs. 1—3; pl.12, fig.7.

1937. *Blackwelderia octaspina* Endo et Resser, Manchurian Sci. Mus. Bull. 1,p.188, pl.51, fig.23.

Only a pygidium is presented in the collection from South Manchuria. The pygidium is identical with Kobayashi's and Endo and Resser's specimens in the very broad semi-elliptical outline, in the presence of eight pairs of marginal spines of which the first pair are very large and long. Kobayashi (1942, p. 208) synonymized *octaspina* with *monkei* chiefly for the reasons that the pygidia of these two species resemble each other in most characteristics. He stated that the difference in number of the marginal spines, (i. e. seven pairs in *monkei* and eight pairs in *octaspina*) is due to different stages of growth. *Monkei* is considered by the author to be the young form of *octaspina*. The specimen illustrated on Pl. V, fig. 16 as *B. monkei* from Erhtaokou of Liaoning is certainly not a young form. It has a length of 12 mm. and also it has only seven pairs of marginal spines similar to those figured by Monke and Walcott. Furthermore, *monkei* has a small triangular area on each side of the anterolateral angles while in *octaspina* the first marginal spine issues forth directly from the border without a triangular area in the anterolateral angles. Therefore, the writer is inclined to believe that *octaspina* is an independent species, and is closely related to *monkei* in many features.

**Horizon and locality:** *Blackwelderia paronai* zone, Yaopu, east of Tien-shihfu, Pencu district, Liaoning (BE876).

***Blackwelderia* (?) sp.**

(Pl. IV, fig. 14)

A badly preserved pygidium has a subtriangular outline, a narrow, conical axial lobe divided by 6—7 transverse furrow and an ill-defined border carrying seven pairs of equally strengthened marginal spines. It is more closely related to *Blackwelderia* than to any other genera of the subfamily Demesellinae, but the border is usually more clearly defined in *Blackwelderia* than in the present form. Compared with *Stephanocare*, the pygidium of our form is more triangular in shape, and the pleural furrows are relatively wider and deeper. It is rather doubtful whether the present form should be referred to *Blackwelderia*; it is certainly not closely related to any of the typical species of the genus.

**Horizon and locality:** *Drepanura premesnili* zone; Wutingshan, Yentai of Liaoyang, Liaoning (BE414).

**Genus *Blackwelderioides* Hupé, 1953****Genotype: *Stephanocare? monkei* Walcott 1911*****Blackwelderioides monkei* (Walcott)**

(Pl. V, fig. 16)

1903. *Stephanocare* sp. Monke, Jahrb. Kongl. Preuss. Geol. Landesanst. u. Bergakad. Bd.23, Heft. 1, p. 144, pl.8, figs.1, 1a, 2—4.

1911. *Stephanocare? monkei* Walcott, Smithson. Misc. Coll., vol.57, no.4, p.77, pl.14, fig.7.

1913. *Stephanocare? monkei* Walcott, The Cambrian Faunas of China, p.113, pl.8, fig. 5.

1942. *Blackwelderia monkei* Kobayashi, Journ. Geol. Geogr., vol.18, no.4, p.208, pl.21, fig.3.

No heads have been found in our collections. The specimen here referred to *B. monkei* agrees fairly well with the Monke's pygidia as well as with the Walcott's in the semi-elliptical outline, in the ribs with equal width, in the presence of a triangular area on each anterolateral corner and in having seven pairs of marginal spines of which the anterior ones are much longer and larger than the others. The length of our specimen measures about 12 mm, while the pygidia figured by Monke and Walcott range from 5 to 6 mm.

**Horizon and locality:** *Drepanura premesnili* zone; Erhtaokou, Yingtze of Penchi, Liaoning (BE123).

**Genus *Stephanocare* Monke, 1903****Genotype: *Stephanocare richthofeni* Monke, 1903*****Stephanocare ordosensis* Chu (sp. nov.)**

(Pl. IV, figs. 15—16)

**Description:** Pygidium subsemicircular in outline, exclusively of the marginal spines. Axial lobe convex, elevated above the pleural lobes, tapering regularly backwards and rounded at the rear, divided into five rings in addition to an articulating half ring and a small terminal lobe by six transverse furrows. Pleural lobe gently

convex, sloping somewhat abruptly downward in the exterior half, separated by furrows into six ribs and a central portion which extends down from the axis; pleural furrows deep and wide, extending directly outward to the margin, interpleural grooves faintly marked on the anterior portion of the pleural lobe. Marginal border practically undefined. Seven pairs of long marginal spines present, among them the posterior one is relatively short and slender. Surface smooth.

**Remarks:** No cephalon and thorax are found in the present collection. The exact affinities of this species are unknown. Its reference to *Stephanocare* is based upon closest similarities of the pygidia of the two forms. It differs from the genotype, *S. richthofeni* Monke, in the non-granulated surface and in the length and number of the marginal spines. The present species has seven pairs of marginal spines, while the species of *S. richthofeni* has six pairs. Walcott's pygidium of *Stephanocare*? sp. (Walcott 1913, p. 116, pl. 8, fig. 6) from Shantung has also seven pairs of marginal spines, but its axial lobe is comparatively short and the anterior pairs of the marginal spines extend directly backward instead of extending obliquely outward as in the present species. The Shantung form is very small (about 3 mm long) and is considered by Kobayashi (1941, p. 45) to be a young stage of *S. richthofeni*.

**Horizon and locality:** Kushan formation, Pe-kou of Yuan-tze-wan, Tsingshuiho district of Inner Mongolia.

### Genus *Damesops* Chu (gen. nov.)

#### Genotype: *Damesops convexus* Chu (sp. nov.)

**Diagnosis:** Cranidium subtrapezoidal in outline, very broad. Glabella convex, broadly conical, wider than long, rounded in front, extending anteriorly to the marginal furrows, with three pairs of oblique glabellar furrows. Dorsal furrows strong. Brim absent; border very narrow, flat; frontal margin straight. Occipital furrow wide, rounded and transverse. Occipital ring uniform in width. Fixed cheek strongly convex, as wide as the glabella between the eyes. Palpebral lobe median sized, located at the midlength of the cranidium. Ocular ridge faintly defined. Posterior limb subtriangular, separated from narrow posterior border by a broad posterior marginal furrow. Surface pustulate.

**Remarks:** This new genus is closely allied to *Damesella* Walcott in some aspects, but it differs from the latter in having a broad, conical glabella, in the very narrow and flat border and in the strongly elevated fixed cheeks. It is also somewhat similar to *Blackwelderia* Walcott, but differs in the absence of concave brim, in having a broader cranidium and in the conical glabella.

**Geological and Geographical Distribution:** *Blackwelderia paronai* zone, Early Upper Cambrian Kushan Formation, Chiawang coal field, northern Kiangsu (Ls49).

***Damesops convexus* Chu (sp. nov.)**

(Pl. V, figs. 2—3)

**Description:** Glabella convex, conical, tapering rapidly forwards, rounded in front, strongly sloping downwards anteriorly, with a length about four-fifths the width at the base. Three pairs of oblique glabellar furrows present: posterior pair deep and long, running directly inwards and backwards, at a distance about one-third the width of the glabella; second pair extending in a same direction as the preceding one, but comparatively short, anterior pair very short, only faintly impressed on the sides. Occipital furrow broad, deep and straight. Occipital ring convex, uniform in breadth in the middle portion, narrowing laterally. Border very low, narrow and flat, with straight frontal margin. Fixed cheek about two-thirds the breadth of glabella at the base, strongly convex from back to front, sloping down abruptly towards the dorsal furrows. Palpebral lobe only partly preserved on the right side to the observer, but judging from the posterior of the ocular ridge and from the course of the posterior facial sutures, the eye may be of median size, located at the midlength of the cranium. Ocular ridge weak, horizontally extending outwards from the dorsal furrows opposed to the first glabellar lobe. Posterior marginal furrow deep and wide, uniform in breadth throughout. Posterior border narrow, moderately convex, nearly equal to occipital ring in sagittal length. Anterior branches of facial sutures damaged; posterior branches running obliquely backwards from the eye in a smooth sigmoid curve.

Surface of cranium marked by finely granules and scattered pustules.

Associated pygidium subtriangular in shape. Axial lobe convex, cylindroconical, divided into 5—6 rings beside an articulating half-ring and a rounded terminal lobe. Pleural lobe gently convex, divided into about 6 ribs by wide and shallow pleural furrows. Interpleural grooves well-defined on first three ribs. Seven pairs of marginal spines present, among them the sixth ones are long and large, extend slightly oblique outwards from the sixth segment, and the last pair of spines very short, flat and triangular in outline. Except on all furrows, surface with scattered pustules.

**Remarks:** The cranium of the present form somewhat resembles *Blackwelderia tschanghsingensis* Endo, which is considered in 1942 by Kobayashi as a variety of *B. sinensis* (Bergeron), but Endo's species has narrow, tuncato-conical glabella and wider frontal border. The pygidium provisionally assigned to this species is like that of *Blackwelderia biloba* Kobayashi from Tawenkou of Shantung in having a pair of triangular flat lobes on the posterior margin, but the space between the two macro-spines of the posterior pair is much narrower and the macro-spines of the second pair are directing more obliquely outwards in our form. It is a rare form in the Kushan Formation of northern Kiangsu. So far only the genotype is known.

**Horizon and locality:** *Blackwelderia* paronai zone; Chiawang coalfield, northern Kiangsu (Ls49).

**Subfamily Chiawangellinae Chu (subfam. nov.)**

**Diagnosis:** Damesellidae with medium, posterior eyes and distinct ocular ridge; pygidium with narrow pleural lobes and three pairs of marginal spines of different strength.

**Genus *Chiawangella* Chu (gen. nov.)****Genotype: *Chiawangella pustulosa* Chu (sp. nov.)**

**Diagnosis:** Glabella long, convex, suboval in shape, with two pairs of short and deep glabellar furrows. Dorsal furrow deep at sides, shallowing anteriorly. Border short, upturned; marginal furrow broad and very deep, margining into dorsal furrow. Occipital furrow well defined; occipital ring slightly widening in middle, median node may be present. Fixed cheek about two-thirds the width of glabella between the palpebral lobes, inclined steeply toward the dorsal furrow. Palpebral lobe of medium length, situated posterior to the midline of glabella; ocular ridge well-defined. Facial sutures extending slightly convergent forwards, cutting the frontal border in a broad curve.

Thorax unknown.

Pygidium excluded marginal spines elongate oval or subtrapezoidal in outline, sides converging posteriorly. Axis convex, cylindro-conical, with five or more rings; dorsal furrow present. Pleural lobes narrower than axis, divided by two pairs of broad furrows; anterior segment ending in a slender spine, second segment rather large, extending postero-laterally into a long and powerful lateral spine; posterior area flattened, with a pair of slender spines. Posterior margin straight or rounded.

**Remarks:** It is proposed to include in the genus *Chiawangella* besides the genotype, a species described by Walcott as *Albertella pacifica* which is known only from an imperfect pygidium. This genus may be placed in the Damesellidae, because the structure of the cranidium appears to be similar to *Damesella* Walcott 1905. If only the pygidia were known, it is impossible to form a definite opinion whether the present genus is related to the genera of Albertellidae and Zecanthoididae or to the genera *Albertella*, *Prozacanthoides*, and *Mexicaspis* of Dolichometopidae. All that can be said is that the cranidia of our form are very different. In Damesellidae, although the shape of the cranidia may vary from semicircular to broad semielliptical, the glabellae are exceptionally oval, conical or truncato-conical in outline, the palpebral lobes are small or medium in size. In Albertellidae, Zecanthoididae or Dolichometopidae, the glabellae are cylindrical or more commonly expanded forward and the palpebral lobes are frequently large.

On the other hand, the cranidium of *Chiawangella* is quite allied to Crepicephalidae, especially to the genus *Crepicephalina* Resser and Endo of the Middle Cambrian of eastern Asia in its posterior eyes, long glabella and narrow brim, although

the pygidium has narrow pleural lobes and has three instead of one pair of marginal spines. It is possible that the early Upper Cambrian *Chiawangella* may be a descendant of *Crepicephalina*.

**Geological and Geographical Distribution:** Kushan Formation of North and Northeastern China.

***Chiawangella pustulosa* Chu (sp. nov.)**

(Pl. V, figs. 4—7)

**Description:** Cranidium broad, convex. Glabella long, suboval in shape, the sides tapering rapidly toward the rounded front, strongly convex from side to side, sloping down anteriorly. Two pairs of deep glabellar furrows present: first pair very short, pitted on the sides closed to the dorsal furrows; second pair rather long and broad, shallowing rapidly inwards and backwards. Dorsal furrow deep posteriorly, converging forwards and merging into the frontal marginal furrow. Frontal marginal furrow very wide and deep, distinctly depressed; frontal border short, convex, erected and sharply ridged; frontal margin slightly convex forwards. Occipital furrow narrow and deep, slightly arching backwards; occipital ring strongly convex in sagittal section, expanded in the middle with a small median tubercle at the center. Fixed cheek moderately convex, about two-thirds the breadth of glabella between the palpebral lobes, sloping steeply towards the dorsal furrow. Palpebral lobes of medium sized, crecentic, situated posterior to the midlength of glabella; ocular ridges distinct, extending obliquely backwards from the dorsal furrow and forming an angle about  $60^\circ$  to the axial line. Anterior branches of facial sutures running slightly convergent from the palpebral lobes forwards and cutting the frontal border in a semicircular curve; posterior branches unknown.

Pygidium, exclusive of the marginal spines, elongate subtrapezoidal in outline, widening anteriorly. Axis large, cylindro-conical, rounded behind, strongly elevated above the pleural lobe, divided by very deep and broad transverse furrows into four rings in addition to an articulating half ring and a rounded end lobe. Dorsal furrow deep and wide. Pleural lobe narrow, about one half the breadth of the axis, marked by two broad furrows; anterior furrow deep, oblique, posterior furrow faint, rather narrow. Articulating segment of pleural lobe convex, small, ending in a slender lateral spine; second segment which is formed by the union of the second to fourth ribs, very large, extending directly oblique backwards into a large and long spine. Posterior area flat, with a pair of slender and short spines. Posterior margin straight.

Surface pustulate, especially on the axial portion which is crowded with numerous granules of different sizes.

**Remarks:** The above description is based upon several cranidia and pygidia in a light grey limestone from one collection. The specimens are well preserved and retain the surface pattern.

**Horizon and Locality:**

*Drepanura premesnili* zone, Chiawang coal field

of northern Kiangsu (Ls56).

***Chiawangella pacifica* (Walcott)**

(Pl. V, figs. 8—9)

1911. *Albertella pacifica* Walcott, Smiths, Misc. Coll., Vol. 57, No.4, pp. 76—77.

1913. *Albertella pacifica* Walcott, Research in China, Vol. 3, p. 106, pl. 12, fig. 3.

1937. "*Albertella*" *pacifica* Resser and Endo. Manchurian Sci. Mus. Bull. no. 1, p. 163, pl. 50, fig. 3.

**Description:** Pygidium elongate cylindro-conical in outline, exclusive of the marginal spines. Axis long, very large, subcylindro-conical, separated by deep and wide transverse furrows into seven rings, convex from side to side, sloping down posteriorly toward the flat posterior area. Dorsal furrows distinct. Pleural lobe very narrow, flat, about one-third the width of axis, rather short. Posterior margin slightly arching backwards. Surface apparently smooth.

**Remarks:** Walcott assigned this species to *Albertella* because of the presence of one pair of marginal spines. Its reference to *Albertella* has been questioned by Kobayashi (1935, p. 270) and later by Resser and Endo (1937, p. 163) not only because of the differences in the structure of the pygidia, but also because of the areal and time displacements between the American and Asiatic species. The assignment of this species to *Chiawangella* is based upon close similarities between it and the genotype in outline and structure of the pygidium, and the presence in both species of three pairs of marginal spines. The two known species of *Chiawangella* differ from each other in several features which are not considered to be of generic value: 1) in *pacifica* the posterior margin of the pygidium is convex rearward while that of *pustulosa* is straight; 2) the pleural lobe of *pacifica* is narrower than that of *pustulosa*; and 3) the surface ornamentation is different in two species.

**Horizon and localities:** *Drepanura premesnili* zone of Yaopu, Tien-shihfu of Penchi (BE875) and Wutingshan, Yentai of Liaoyang, (BE410) Liaoning province.

**Family? Menomoniidae Walcott, 1916**

**Genus *Paramenomonia* Chu (Gen. nov.)**

**Genotype: *Paramenomonia conica* Chu (sp. nov.)**

**Diagnosis:** Opisthoparian trilobite with elongate subtrapezoidal cranium and smooth test. Glabella conical, marked by three pairs of ill-defined glabellar furrows. Dorsal furrows strong. Border convex, angulate antero-laterally. Brim narrow, distinctly depressed, with a circular node on each side. Occipital ring uniform in breadth. Occipital furrow distinctly defined. Fixed cheek frequently elevated. Palpebral lobe small, situated in front of the midline of the glabella; ocular ridge absent. Posterior limb subtriangular, nearly as wide as the glabella at the base. Facial suture slightly divergent anteriorly and somewhat diagonal posteriorly.

**Remarks:** This new genus is very similar to *Menomonium* Walcott 1916 from the

early Upper Cambrian *Cedaria* zone and *Crepicephalus* zone of North America. They agree with each other in the general shape of the glabella, in the broad border and a depressed brim, in the narrow fixed cheek and in the small palpebral lobe. The chief differences are: in *Menomonina* the facial suture cuts the outer posterolateral side of the cephalon in advance of the genal angle, therefore it is a proparian nature; while in *Paramenomonina* the facial suture cuts the posterior margin within the genal angle and it belongs certainly to the opisthoparian. The brims are depressed in both genera but in *Paramenomonina* there are a pair of circular nodes which have not existed in *Menomonina*. Furthermore, the posterior limb is frequently wider and the palpebral lobe is often located more anterior in *Menomonina* than in our new genus.

**Geological and Geographical Distribution:** *Drepanura premesnili* zone of Taitzeho Valley, Liaoning.

***Paramenomonina conica* Chu (sp. nov.)**

(Pl. V, figs. 10—11)

**Description:** Cranium convex, subtrapezoidal in outline, with a breadth in front usually shorter than one-half the breadth at the base. Glabella convex, conical, about two-thirds as long as the cranium. With three pairs of glabellar furrows: first pair of the furrows extending nearly horizontally inwards, second ones slightly oblique backwards, third pair strongly oblique making an angle about  $60^\circ$  to the dorsal furrows. Dorsal furrows deep around both sides as well as in the front of the glabella. Border convex, sloping gently anteriorly, well-defined by a straight furrow behind and by two concave furrows posterolaterally. Brim narrow, distinctly depressed in front of the glabella and provided a pair rounded nodes at the sides. Occipital ring convex, uniform in breadth, wider than the base of glabella. Occipital furrow shallow and straight in the central portion, deepening and curving forwards at the both sides. Palpebral lobe small, located just in front of the midlength of glabella; ocular ridge obscure. Fixed cheek narrow, a little less than one half the width of the glabella at the base. Postero-lateral limb subtriangular, as wide as the glabella, gently sloping laterally. Posterior marginal furrow broad; posterior border distinct and narrow, extending from dorsal furrows directly outwards and slightly backwards. Anterior branches of facial sutures slightly diverging forwards from the palpebral lobe, cutting the frontal margin about a right angle; posterior branches long, running obliquely backwards and outwards, cutting the posterior margin within the genal angle. Surface smooth.

**Horizon and Localities:** *Drepanura premesnili* zone; Wutingshan, Yentai of Liaoyang (BE414) and Erhtaokou, Yingtze of Penchi, Liaoning (BE121).



**Superfamily Dikelocephalacea Richter 1932, emend. Hupé, 1953.****Family Anomocaridae Poulsen, 1927, emend. Hupé, 1953.****Genus *Wutingshania* Chu (Gen. nov.)****Genotype: *Wutingshania lui* Chu (sp. nov.)**

**Diagnosis:** Opisthoparian trilobite with smooth test. Glabella short, truncato-conical, unfurrowed. Dorsal furrows deep at the sides and shallow in front of the glabella. Frontal area long, concave, expanded forwards and angulated in front. Occipital ring uniform in breadth. Palpebral lobes large, crescentic, situated posterior of cranidium; ocular ridges well-defined. Fixed cheek about the same width of the glabella between the eyes. Facial sutures diverging anteriorly, then bending strongly inwards along the margin to meet to each other in the front and finally united into a single longitudinal line across the doublure. Free cheek broad and nearly flat, border very wide, producing postero-lateral into a large spine, doublure very wide, marked by fine concentric lines.

**Remarks:** *Wutingshania* may be a descendant of *Haniwoides* Kobayashi from the *Olenoides* zone of S. Korea. It agrees well with Kobayashi's genus in the short, unfurrowed glabella, in the broad, concave frontal area, in the course of facial sutures and in the form of free cheek. But the glabella of *Haniwoides* is more broad and is subquadrate in shape, the palpebral lobe is close to the glabella and there is no trace of ocular ridge.

The new genus is also somewhat similar to *Lioparia* Lorenz 1906, but it differs from the latter in the unfurrowed glabella, in the expanded forwards and angulated frontal area, in the larger palpebral lobe, in the course of facial sutures and in the narrower posterior border.

**Geological and Geographical Distribution:** *Drepanura premesmili* zone of Taitzeho valley, Liaoning.

***Wutingshania lui* Chu (sp. nov.)**

(Pl. V, figs. 12—15)

**Description:** Glabella short, moderately convex, truncato-conical, rounded in front, occupying about one half the total length of the cranidium. Glabellar furrows obscure. Dorsal furrow deep at the sides, shallowing forwards and inwards and scarcely perceptible in front of the glabella. Frontal area a little more than one-third the length of the cranidium, expanded anterolaterally, flattenedly concave, slightly rised near the margin, undifferentiated into brim and border. Frontal margin extending inwards and slightly forwards from the antero-lateral corners to make an obtuse angle at the middle. Occipital furrow well-defined, transverse; occipital ring uniform breadth, gently convex. Palpebral lobe large, crescentic, located fairly back. Ocular ridge well-defined, short, extending slightly oblique backwards from the dorsal furrows opposed to the anterior fourth of the glabella. Fixed cheek slightly convex,

about two-thirds as wide as the glabella at the base. Posterior border narrow, uniform in breadth throughout. Posterior marginal furrow well-defined. Free cheek comparatively large, nearly flat, with broad border. Genal spine short, more than one-third the length of the free cheek. Doublure very broad, marked by numerous fine concentric lines subparallel to the margin. Anterior branches of facial sutures long, slightly divergent from palpebral lobes forwards, then bending strongly inwards near the margin and extending slightly forwards to meet at the middle in the front and finally united into a single longitudinal line across the doublure; posterior branches very short, extending slightly oblique backwards from the base of palpebral lobe and cutting the posterior margin well within the genal angle. Surface smooth.

**Horizon and Localities:** *Drepanura premesnili* zone; Erhtaokou, Yingtze of Penchi (BE121) and Wutingshan, Yentai of Liaoyang, Liaoning (BE410, BE409).

**Superfamily Dikelocephalacea Richter 1932, emend. Hupé 1953.**

**Family Dikelocephalidae Miller, 1890**

**Subfamily ?Dikelocephalinae Beecher 1897, emend. Hupé 1953**

**Genus *Liaoningaspis* Chu (Gen. nov.)**

**Genotype: *Liaoningaspis taitzeensis* Chu (sp. nov.)**

**Diagnosis:** Glabella subcylindrical, widening very slightly posteriorly. Glabellar furrows weakly defined. With a pair of small, oval lobes at the posterolateral portion of the glabella, outside the dorsal furrow. Brim very broad and long, gently concave, slightly upturned near the frontal margin which is marked by irregular concentric striae, well defined posteriorly from the glabella by a low elevation subparallel to the frontal margin. Occipital ring provided with a very small node. Palpebral lobe large, situated in a position a little behind the midline of the glabella. Fixed cheek small. Free cheek large; genal angle rounded. Thorax unknown. Pygidium moderately convex, broad than long. Axis convex, cylindro-conical, composed of 6 rings and an articulating half ring; pleural lobe subtriangular, marking by 4–5 pleural furrows; posterior limb broad, slightly concave and provided with irregular concentric striae along the margin. Doublure very broad, marked by irregular inosculating lines on the exfoliated specimens. Two pairs of small serrated spines extending from the lateral margin directed backwards and slightly outwards.

**Remarks:** This genus is closely allied to *Paracopsis* Kobayashi 1936, from which it differs in having subcylindrical glabella, in the presence of a pair of oval lobes at the postero-lateral angle of the glabella, in the absence of genal spine on the free cheeks and in having two pairs of small serrated spines at the lateral margin of pygidium.

*Lauzonella* Rasetti 1944 from Levis conglomerate of Quebec Canada, is somewhat similar to our new genus, but the Canadian form is easily distinguished by its narrower fixed cheek without oval lobes at the postero-lateral angle of the

glabella, by the narrower pygidial axis and by the rounded antero-lateral angles in the pygidium.

*Liaoningaspis* also resembles *Lioparia* Lorenz 1906 and *Dikelocephalites* Sun 1935 found in the Changshan Formation, but the new genus is different from both genera in the comparatively narrow brim, in having a pair of peculiar small lobes on the fixed cheeks and a low elevation at the front of the glabella and in the presence of two pairs of small serrated spines at the lateral margin of the pygidium. It is also distinguished from *Dikelocephalites* by the weakly defined and discontinuous glabellar furrow and by the comparatively wider fixed cheek.

**Geological and Geographical Distribution:** *Blackwelderia paronai* zone, Taitzeho Valley of Liaoning, Tsingshuiho District of Inner Mongolia and Chia-hsiang of Shantung.

***Liaoningaspis taitzehoensis* Chu (sp. nov.)**

(Pl. VI, figs. 1—9)

**Description:** Cranidium roughly subquadrate in outline. Glabella convex, longer than wide, subcylindrical, very gradually tapering forwards, rounded in front and slightly carinate along the axial portion. Two pairs of shallow, oblique glabellar furrows faintly defined. Dorsal furrow narrow but distinctly marked. Occipital furrow narrow, shallow, slightly arching posteriorly at the center. Occipital ring of medium width, convex, with a small node in front of the center. Brim gently concave, slightly upturned near the frontal margin, as wide as the distance between the palpebral lobes and about one-third the length of the cranidium, marked by irregular, concentric striae along the margin. Posteriorly, the brim is limited by a low but distinct elevation running along the frontal margin of the glabella in a smooth curve towards the sides. Palpebral lobe large, located just behind the midline of glabella; ocular ridge faintly marked. Fixed cheek gently convex, about one half the basal width of the glabella, with a small oval lobe closed to dorsal furrow opposing the posterior lobe of the glabella.

Free cheek large, eye platform narrow, with a very broad, concave border marked by irregular striae along the margin. Genal angle rounded. No genal spine.

Anterior branches of facial sutures diverging from the palpebral lobe forwards then curving strongly inwards to cut the frontal margin in a semicircular curve line; posterior branches shorter, passing directly outwards and then bending strongly backwards to cut the posterior margin well within the genal angle.

Thorax unknown.

Pygidium transversely subelliptical in outline, moderately convex, short, about one half as long as wide. Axis narrow, convex, cylindro-conical, tapering gradually backwards, rounded behind, with 5 rings besides the articulating halfring and the end lobe. Pleural lobe subtriangular, marked by 4 pleural furrows of which the first, second and third ones are rather long and well-defined, the fourth is very short and

faint. Posterior limb of pygidium broad, slightly concave, ornamented with some fine irregular concentric striae near the posterior margin and with two pairs of small serrated spines extending from the lateral margin directed backwards and slightly outwards. Doublure very broad, concave, marked by numerous inosculating lines more or less parallel to the margin.

Test smooth.

**Horizon and localities:** *Blackwelderia paronai* zone of Lotolingtze, north of Yingtze, Penchi, Liaoning (BE385); Tangshihling, Yentai of Liaoyang (BE448); Erhtaokou, Yingtze of Penchi (BE124), Liaoning, and Chiahsiang of Shantung.

***Liaoningaspis* sp.**

(Pl. VI, fig. 10)

A flattened incompletely preserved pygidium; pygidium is similar to the genotype in the presence of two pairs of serrated spines on the lateral margin and in the very broad posterior limb, but the axial lobe is relatively wider and the pleural furrows direct more oblique backwards. The poor preservation renders reliable identification impossible.

**Horizon and Locality:** *Blackwelderia paronai* zone, Tsingshuiho District of Inner Mongolia.

**Subfamily Osceolinae Ulrich et Resser, 1930**

**Genus *Walcottaspidella* Chu (gen. nov.)**

**Genotype: *Walcottaspidella suni* Chu (sp. nov.)**

**Diagnosis:** Glabella subquadrate in outline, gently convex. Glabellar furrows obsolete. Brim of medium size, concave, slightly upturned along the margin; frontal margin gently convex forwards. Dorsal furrows very shallow. Occipital furrow deep in the central portion, shallowing and extending forwards laterally, forming a broad V-shape. Occipital ring gently convex, narrow in center, widening towards both sides, with a small median tubercle. Palpebral lobe medium sized, crescentic, situated posteriorly to the midline of the cranium. Ocular ridge faint. Fixed cheek nearly flat, narrow, with a small semi-circular lobe opposite the postero-lateral angle of the glabella. Anterior facial sutures slightly diverging forwards.

Pygidium transverse elongate elliptical in outline, moderately convex. Pleural portion faintly furrowed into 5 ribs, with very broad and slightly concave border.

**Remarks:** In the short glabella and in the obsolete glabellar furrows *Walcottaspidella* agrees with *Walcottaspis* Ulrich and Resser 1930 from the Trempealeonian of North America, but the brim is rounded instead of more or less angulate in front, the occipital ring is narrow in center instead of uniform throughout in the American form, and the anterior facial sutures are less divergent forwards. Moreover, there are a pair of small lobes on the fixed cheeks. In this respect the new genus resembles

*Liaoningaspis*, but they differ greatly from each other in the shape of glabella, in the size of the fixed cheek, in the relative length of brim and in the course of the facial sutures. The pygidium of *Walcottaspidella* is more like that of *Liaoningaspis* than that of *Walcottaspis* in the almost complete obliteration of the interpleural grooves and in the general outline, but the lateral margin is not spinosed as in *Walcottaspidella*.

**Geological and Geographical Distribution:** *Drepanura premesmili* zone of Taitzho Valley, Liaoning.

***Walcottaspidella suni* Chu (sp. nov.)**

(Pl. VI, figs. 11—12)

**Description:** Cranidium roughly subquadratical in outline, very slightly convex. Glabella gently convex, a little longer than wide, subquadratical, verly slightly tapering anteriorly, with rounded antero-lateral angles. Glabellar furrows very faint, only the posterior pair observable under oblique light, they extending from the dorsal furrow obliquely inwards and rearwards at the posterior fourth of the length of glabella towards the occipital furrow form a right triangle on each side of the glabella. Brim concave, slightly upturned near the margin, narrower than the distance between the palpebral lobes, about one-fifth the total length of the cranidium. Frontal margin slightly arched forwards forming a smooth convex curve. Occipital furrow broad V-shaped, rather deep in the middle portion, shallowing and extending slightly oblique forwards laterally. Occipital ring wider on the sides, narrowing and rising medially, provided with a small tubercle at the center, posterior margin slightly arched rearwards. Palpebral lobes of medium size, bow-shaped, situated at a position posterior to the midlength of the cranidium. Ocular ridges faintly defined, running from the dorsal furrows opposing the anterior fourth of the glabella in a low and weak elevation obliquely rearwards. Fixed cheek narrow, very gently convex, about one-fourth the width of the glabella, with a small, ill-defined semicircular lobe closed the dorsal furrow opposite the posterior lobe of glabella. Posterior limb imperfectly preserved, slightly convex, divided by a well-defined marginal furrow from the narrow posterior border. Anterior branches of facial sutures slightly divergent anteriorly, cutting the frontal border in a rounded angle. Thorax unknown.

Pygidium broad, elongate elliptical in outline, anterior margin bending backward in a uniform curvature, posterior edge arching posteriorly in less curvature. The axial lobe is so incomplete that only the posterior part retains a bit of the end lobe that indicate the normal extension of the axis. It is about three-fourths the total length of the pygidium, subconical in outline with rounded end. Pleural lobe broad, divided into an indefinitely outlined, triangular slightly convex area and a wider, first concave, then horizontally flattened, rim less outer area. The latter is marked by very fine concentric striae near the margin. Five pairs of shallow furrows extending obliquely backward from the dorsal furrow and died out on the flattened marginal

area. Doublure wide, ornamented with numerous fine terraced lines.

**Horizon and locality:** *Drepanura premesnili* zone, Yaopu, east of Tien-shihfu, Penchi, Liaoning (BE874).

**Genus *Kushanopyge* Chu (gen. nov.)**

**Genotype:** *Kushanopyge serrata* Chu (sp. nov.)

**Diagnosis:** Pygidium subelliptical in outline. Axial lobe narrow, subconical, strongly convex, elevated above the pleural lobes, about three-fourths the total length of the pygidium, divided into seven segments by transverse furrows which are rather shallow on the axial portion; last segment subtriangular, provided a low elevation on the each side of the axial line. Pleural lobe gently convex at the inner half, sloping down to the broad, slightly concave and quite unrimmed border, divided into seven or more flat-topped ribs by curving pleural furrows which proceed continuously and widen more or less decidedly outward from the dorsal furrow. Each rib terminated with a short, serrated spine. Doublure very broad, marked by fine concentric striae. Surface smooth.

**Remarks:** Though represented only by the pygidium figured, the form is so characteristic that it seem to deserve a new generic name. The writer can't find any forms which are similar to it in any other early Upper Cambrian fauna. In the broad concave unrimmed border and the serrated posterior margin, the pygidium of *Kushanopyge* is somewhat similar to that of *Hungaia* Walcott from the Upper Cambrian of America and that of *Hungioides* Kobayashi from the Tremadoc of Central Europe, but it differs in the general outline and in the size of axial lobe. The same comparison applies to *Kushanopyge* and *Drepanura* Bergeron, but the latter is quite different in its flattened border, in a pair of large falcate spines, and in the character of pleural furrows.

**Geological and Geographical Distribution:** Kushan Formation of North-eastern and North China.

***Kushanopyge serrata* Chu (sp. nov.)**

(Pl. VI, figs. 13—14)

1913. *Pterocephalus asiaticus* Walcott, Research in China, Vol. 3, p. 146, pl. 14, figs. 5a, 5b only.

This species is represented by a number of pygidia from the zone of *Blackwelderia paronai* at Tangshihling, Yentai colliery of Liaoyang (BE448), and at Yaopu, east of Tien-shihfu, Penchi, Liaoning (BE876). Two fragmentary pygidia figured by Walcott (1913, p. 146, Pl. 14, figs. 5a, 5b) as *Pterocephalus asiaticus* from Yenchuang of Shantung are conspecific and can in no way be separated. These pygidia together with an imperfect cranidium (Walcott, 1913, Pl. 14, fig. 5) have been transferred to *Paracoosia* by Kobayashi (1936, p. 172), but they are quite different from the pygidium of the genotype, *Paracoosia mansuyi* Kobayashi, in having a serrated posterior margin.

**Superfamily Olenacea Hupé, 1953****Family Leiostegiidae Bradly 1925****Genus *Chuangioides* Chu (gen. nov.)****Genotype: *Chuangioides punctatus* Chu (sp. nov.)**

**Remarks:** This genus is definitely allied to *Chuangia* of the Changshan Formation and is believed to be the ancestral type of that genus, but the pygidium is subelliptical instead of semicircular or semielliptical in outline and the surface of the test is roughed by numerous fine granules and small pits. As in *Chuangia* the pleural furrows of this genus are short, but they are rather strong and more deeply incised. Furthermore, the antero-lateral angle of the pygidium is more or less acutely angulated in *Chuangia*, while that of *Chuangioides* is fairly rounded, forming a semicircular curve. Though aside from the few features mentioned above there has no other change either in the shape of the axial lobe or in the morphology of the unrimmed border, yet these few features are sufficient to give a readily distinguishable difference in the appearance of the two genera. Further observations will be found in the description of the genotype.

**Geological and Geographical Distribution:** Kushan Formation, Hsihsien of Shansi Province.

***Chuangioides punctatus* Chu (sp. nov.)**

(Pl. VII, figs. 1, 2)

**Description:** Pygidium subelliptical, with a length a little shorter than one-third the greatest breadth. Axial lobe strongly convex, subconical, elevated above the pleural lobes, more than two-thirds the length of the pygidium, composed of 4–5 segments separated by transverse furrows; first and second furrows deep and narrow, slightly arched forward, posterior furrows very weak. Dorsal furrow deep on the side, shallowing rapidly posteriorly and tapering to a narrow rounded end. Pleural lobe convex, wider than the anterior end of axial lobe, divided into a narrow articulating segment, three short ribs and a broad posterior portion; first or the articulating furrow long and wide, second and third short, but deeply incised, fourth furrow rather shallow. Surface marked by numerous fine granules and small pits.

**Remarks:** This species is represented in the Hsihsien material by several pygidia preserved in limestone. It occurs persistently, though not commonly in the *Blackwelderia paronai* zone fauna in western Shansi.

**Horizon and Locality:** Lower part of Kushan Formation, associated with *Blackwelderia paronai* (Airaghi), *Lorenzella parabola* Lu, etc. at Yungmenshan of Shihkoucheng, Hsihsien, Shansi Province (Sk 18a, Sk 18 and Sk 19).

**Undetermined Damesellidae****Damesellid gen. et sp. undet. no. 1**

(Pl. VII, figs. 11—13)

Pygidium broad, about four times as wide as long. Axial lobe convex, conical, long, abruptly contracted at the rear part to form a short, narrow ridge which extends posteriorly to the margin, composed of five rings separated by curved furrows. Dorsal furrow deep and narrow. Pleural lobe triangular, a little wider than the axis, grooved by deep and wide pleural furrows into 3 to 4 ribs; interpleural grooves faintly marked on the anterior ribs. Six pairs of short marginal spines present, among them the third pair is very short and rather slender and sixth ones are relatively large. Besides the first and second spines which are pointed almost directly rearward, the posterior ones extend obliquely inward. Border narrow.

**Remarks:** The generic assignment cannot be made until the cephalon has been obtained. It is mostly similar to *Stephanocare? sinensis* described and illustrated by Bergeron (1899, p. 508, text-fig. 7, Pl. 13, fig. 7) and by Walcott (1913, p. 116 Pl. 8, figs. 4, 4a), but it differs in the broad axial lobe, a very narrow border and in the posterior spines which direct obliquely inward instead of backwards. The broad outline and large triangular pair of the last spines of both forms do not seem to be referable to any hitherto known genus of the family Damesellidae.

**Horizon and Locality:** *Drepanura premesnili* zone, Wutingshan, Yentai of Liaoyang, Liaoning (BE410).

**Damesellid gen. et sp. undet. no. 2**

(Pl. VII, figs. 5—8)

Pygidium broad, elliptical, the ratio of the length to the width is about 1:3. Axial lobe triangular, moderately convex, narrow, tapering regularly and rapidly posteriorly and ending at a short distance from the margin, divided into 7—8 rings by transverse furrows. Pleural lobe broad, flat, with 3 to 4 ribs; pleural furrows deep in inner portion, disappearing near the margin. No any clear indication of a border. Six pairs of serrated marginal spines of about equal length. Doublure very broad.

**Remarks:** This form is practically identical with *Drepanura pusilla* Resser and Endo (1937, p. 217, Pl. 50, fig. 1; Pl. 63 figs. 14, 15; Pl. 64, figs. 2, 3), but the generic reference of the latter, as has been pointed out by Kobayashi (1941, p. 46), is doubtful, because no pygidium has the first long pair of spines which are the most important characteristics of *Drepanura*.

**Horizon and localities:** *Drepanura premesnili* zone, Erhtaokou, Yingtze of Penchi (BE121) and Wutingshan, Yentai of Liaoyang (BE410), Liaoning, North-eastern China.



**Damesellid gen. et sp. undet. no. 3**

(Pl. VII, figs. 3—4)

Two pygidia were collected from shales at Erhtaokou, Liaoning from the zone of *Drepanura premesnili*. None of the associated cephalon seem to be referable to this form. It resembles but does not seem to be identical with the pygidium described by Resser and Endo as *Drepanura inutilis* (1937, p. 215, Pl. 50, fig. 2). Broadly speaking, it is more closely allied to *Drepanura* than to any other genera of the Damesellidae in its short axial lobe and in the very large first rib, but like *Drepanura inutilis* it is distinct from *Drepanura* by its lack of first pair of long spines.

**Damesellid gen. et sp. undet. no. 4**

(Pl. VII, figs. 9—10)

Two pygidia are strongly similar to Damesellid gen. et sp. undet. No. 2 (Pl. VII, figs. 5—8), but differ from the latter in having comparatively shorter axial lobe, in the straight and short anterior margin and in the oblique backwards anterolateral margin.

**Horizon and locality:** *Drepanura premesnili* zone, Erhtaokou, Yingtze of Penchi, Liaoning (BE121).

**Family Saukiidae Ulrich and Resser, 1933****Saukid gen. et sp. undet. no. 1**

(Pl. 7, fig. 14)

A single small cranidium was obtained from Hsihsien, Shansi, which cannot be compared with any hitherto known genera of the Kushan Formation. The cranidium bears a close affinity to the members of Saukids; the specimen however is so small and ill-preserved that a definite generic and specific determination can't be made, until more complete material is available. The writer has been only content briefly to describe and figure the cranidium for reference and tentatively refers it to the family Saukiidae.

Glabella convex, subcylindrical, with four pairs of discontinuous, shallow, and short glabellar furrows. Occipital furrow well-defined, deep; occipital ring uniform in breadth throughout. Border narrow, convex, separated from glabella by a deep marginal furrow. Fixed cheek very narrow, less than one-third the width of the glabella at the base. Palpebral lobe of median size, situated in the midline opposite to the glabella; no ocular ridge. Surface pustulated.

**Saukid gen. et sp. undet. no. 2**

(Pl. VII, fig. 15)

Only the illustrated young pygidium of Saukid is present. Pygidium small, semicircular in outline measuring 1.8 mm long and 3 mm wide. Axial lobe com-

posed of seven segments, strongly convex, cylindro-conical, tapering gradually backward, abruptly contracted at the hind part to form a narrow, short low ridge which disappears near the margin. Pleural lobe moderately convex, somewhat sloping down to a slightly concave and narrow border, divided into 5 ribs by furrows; anterior pairs of pleural furrows rather deep, extending slightly oblique back from the dorsal furrow, then bending at the outer half strongly backward and dying out on the marginal area; interpleural grooves faintly defined, about one half the length of the ribs. Surface with coarse pustules on the axial portion and finer granules of the pleural lobes.

This pygidium was procured from the Chiawang coal field of northern Kiangsu in a light yellow limestone of the *Drepanura premesnili* zone. Every feature of the specimen joints to its classification as one of the Saukiidae such as the course and the character of the pleural ribs, the concave border, the width and prominence of the posterior axial ridge, and the surface ornamentation. The pygidium is very small and the close relationship of this form is very obscure; it may be a young form of a Saukid.

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# 图 版

## 图 版 說 明

### 图 版 I

#### 图 1—7. *Homagnostus Convexus* Chu (新种)

1. 头部。×6, 辽宁本溪营子二道沟。登記号码: 9409。
2. 头部。×6, 辽宁本溪营子二道沟。登記号码: 9410。
3. 尾部。×6, 辽宁本溪营子二道沟。登記号码: 9411。
4. 尾部。×6, 正型标本。辽宁本溪营子二道沟。登記号码: 9412。
5. 幼虫的头部。×8, 辽宁本溪营子二道沟。登記号码: 9413。
6. 幼虫的尾部。×8, 辽宁本溪营子二道沟。登記号码: 9414。
7. 幼虫的尾部。×8, 辽宁本溪营子二道沟。登記号码: 9415。

#### 图 8—19. *Homagnostus taitzehoensis* Chu (新种)

8. 头部。×3, 辽宁辽阳燧台当十岭。登記号码: 9416
9. 尾部。×6, 辽宁辽阳燧台当十岭。登記号码: 9417。
10. 尾部。×4, 正型标本。辽宁辽阳燧台当十岭。登記号码: 9418。
11. 幼虫的头部。×14, 辽宁辽阳燧台当十岭。登記号码: 9419。
12. 幼虫的头部。×14, 辽宁辽阳燧台当十岭。登記号码: 9420。
13. 幼虫的头部。×10, 辽宁辽阳燧台当十岭。登記号码: 9421。
14. 幼虫的头部。×8, 辽宁辽阳燧台当十岭。登記号码: 9422。
15. 幼虫的尾部。×20, 辽宁辽阳燧台当十岭。登記号码: 9423。
16. 幼虫的尾部。×10, 辽宁辽阳燧台当十岭。登記号码: 9424。
17. 幼虫的尾部。×10, 辽宁辽阳燧台当十岭。登記号码: 9425。
18. 幼虫的尾部。×8, 辽宁辽阳燧台当十岭。登記号码: 9426。
19. 幼虫的尾部。×6, 辽宁辽阳燧台当十岭。登記号码: 9427。

#### 图 20. *Lotagnostus* (?) sp.

- 头部。×6, 辽宁本溪营子二道沟。登記号码: 9428。

#### 图 21—24. *Homagnostus (Quadrahomagnostus) subquadratus* Chu (新亚属, 新种)

21. 头部。×4, 正型标本。辽宁田师付东腰堡。登記号码: 9429。
22. 头部。×8, 辽宁辽阳燧台五顶山。登記号码: 9430。
23. 尾部。×4, 辽宁田师付东腰堡。登記号码: 9431。
24. 尾部。×4, 辽宁田师付东腰堡。登記号码: 9432。

#### 图 25—26. *Homagnostus (Quadrahomagnostus) tienshihfuensis* Chu (新亚属, 新种)

25. 头部。×4, 正型标本。辽宁田师付东腰堡。登記号码: 9433。
26. 尾部。×6, 辽宁田师付东腰堡。登記号码: 9434。

#### 图 27. 种属未定者 a

- 尾部。×8, 辽宁辽阳燧台当十岭。登記号码: 9435

#### 图 28—29. 种属未定者 b

28. 尾部。×8, 辽宁本溪营子二道沟。登記号码: 9436。
29. 尾部。×8, 辽宁辽阳燧台五顶山。登記号码: 9437。

#### 图 30—32. *Liostracina kryausei* Monke

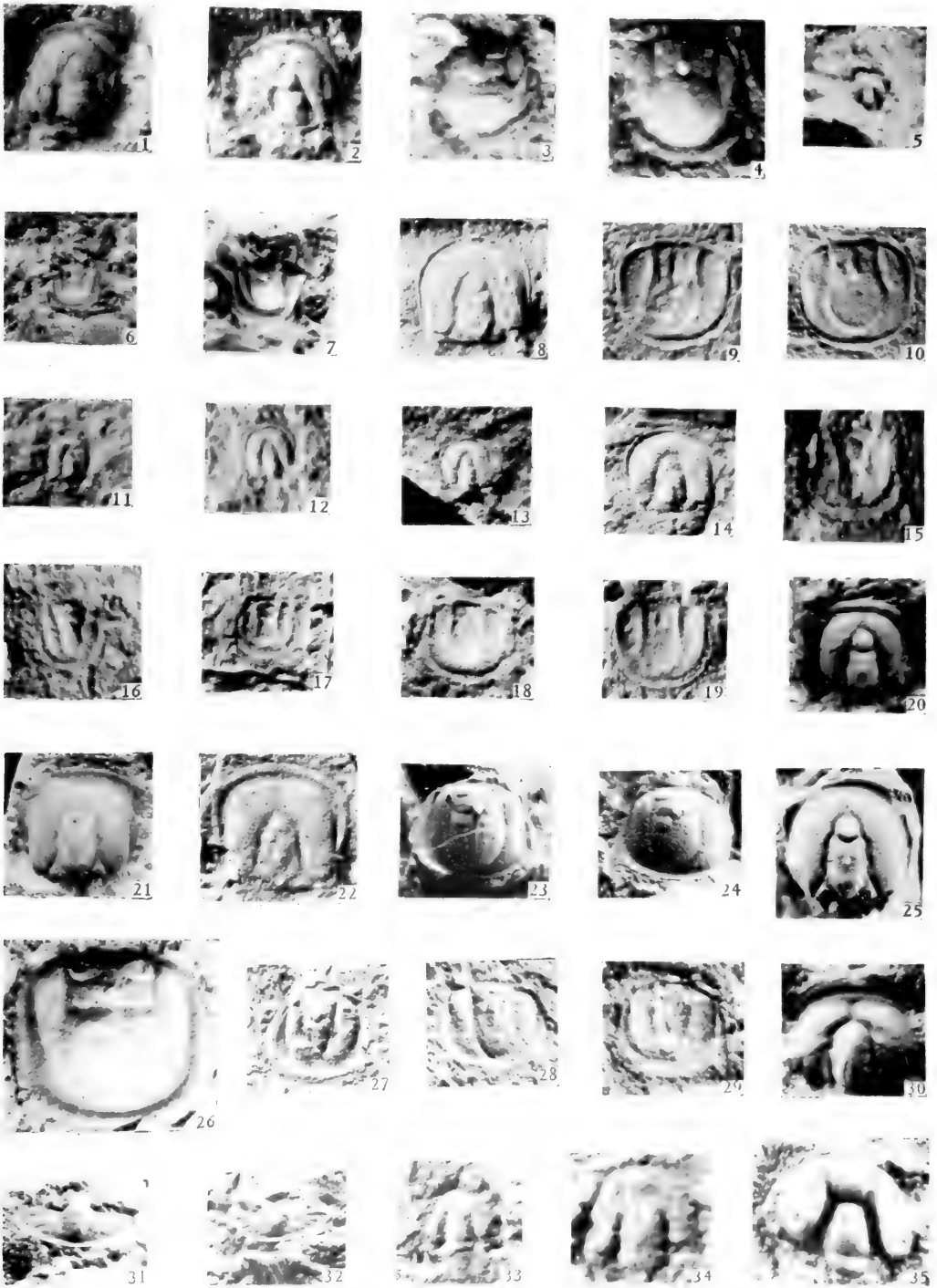
30. 头盖。×6, 江苏北部賈汪。登記号码: 9438。
31. 尾部。×8, 江苏北部賈汪。登記号码: 9439。
32. 尾部。×8, 江苏北部賈汪。登記号码: 9440。

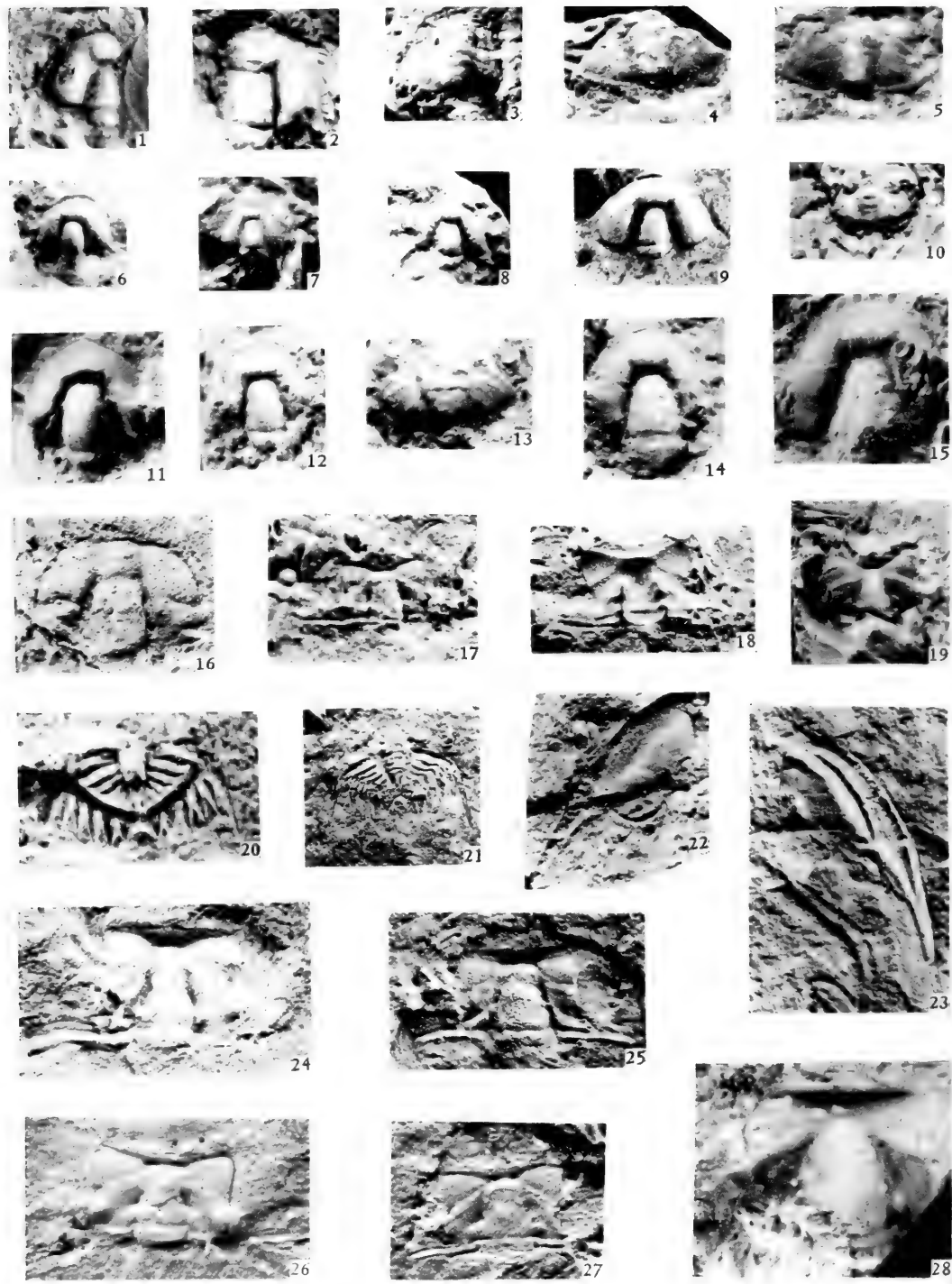
#### 图 33—34. *Tangshihlingia subtriangulata* Chu (新属, 新种)

33. 头盖。×8, 正型标本。辽宁辽阳燧台当十岭。登記号码: 9441。
34. 头盖。×20, 辽宁辽阳燧台当十岭。登記号码: 9442。

#### 图 35. *Lorenzella parabola* Lu

- 头部。×6, 辽宁本溪营子二道沟。登記号码: 9443。







## 图 版 II

### 图 1—5. *Lorenzella parabola* Lu

1. 头部。×6, 辽宁本溪营子二道沟。登记号码: 9444。
2. 头部。×6, 江苏北部賈汪。登记号码: 9445。
3. 尾部。×8, 辽宁本溪营子二道沟。登记号码: 9446。
4. 尾部。×8, 辽宁本溪营子二道沟。登记号码: 9447。
5. 尾部。×8, 辽宁本溪营子二道沟。登记号码: 9448。

### 图 6—8. *Lorenzella pustulosa* Chu (新种)

6. 头盖。×8, 辽宁辽阳烟台当十岭。登记号码: 9449。
7. 头盖。×8, 辽宁辽阳烟台当十岭。登记号码: 9450。
8. 头盖。×8, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9451。

### 图 9—10. *Lorenzella yentaiensis* Chu (新种)

9. 头盖。×8, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9452。
10. 尾部。×10, 辽宁辽阳烟台当十岭。登记号码: 9453。

### 图 11—13. *Lorenzella subcylindrica* Chu (新种)

11. 头盖。×6, 正型标本。辽宁田师付东腰堡。登记号码: 9454。
12. 头盖。×8, 辽宁田师付东腰堡。登记号码: 9455。
13. 尾部。×8, 正型标本。辽宁田师付东腰堡。登记号码: 9456。

### 图 14—15. *Lorenzella kushanensis* Chu (新种)

14. 头盖。×6, 正型标本。山东崮山唐王寨。登记号码: 9457。
15. 头盖。×6, 山东崮山唐王寨。登记号码: 9458。

### 图 16. *Lorenzella* (?) *convexa* Endo et Resser

- 头盖。×3, 辽宁辽阳烟台五顶山。登记号码: 9459。

### 图 17—23. *Teinistion yangi* Chu (新种)

17. 头盖。×5, 辽宁辽阳烟台当十岭。登记号码: 9460。
18. 头盖。×4, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9461。
19. 头盖。×3, 辽宁本溪营子二道沟。登记号码: 9462。
20. 尾部。×6, 辽宁辽阳烟台当十岭。登记号码: 9463。
21. 尾部。×4, 辽宁辽阳烟台当十岭。登记号码: 9464。
22. 活动颞。×5, 辽宁辽阳烟台当十岭。登记号码: 9465。
23. 活动颞。×5, 辽宁辽阳烟台当十岭。登记号码: 9466。

### 图 24—25. *Teinistion tangshihlingensis* Chu (新种)

24. 头盖。×4, 辽宁辽阳烟台当十岭。登记号码: 9467。
25. 头盖。×4, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9468。

### 图 26—27. *Teinistion liaoningensis* Chu (新种)

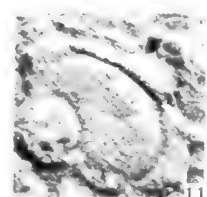
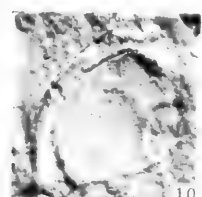
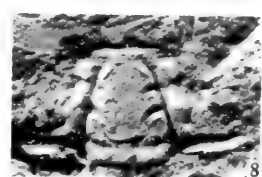
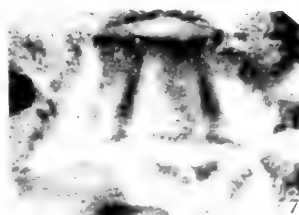
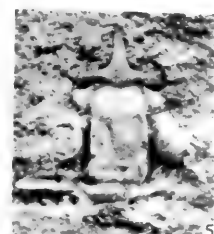
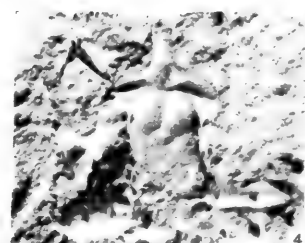
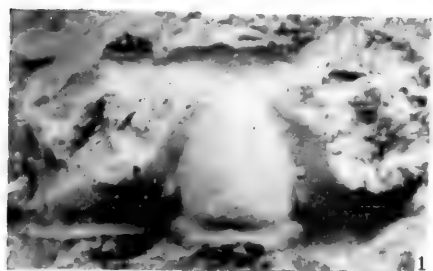
26. 头盖。×4, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9469。
27. 头盖。×4, 辽宁辽阳烟台当十岭。登记号码: 9470。

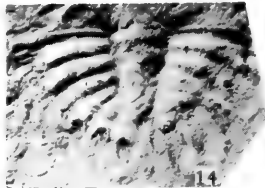
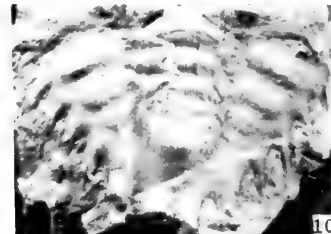
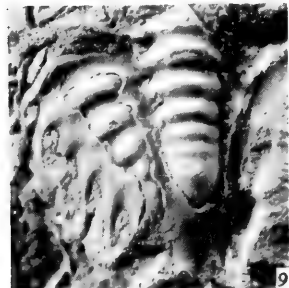
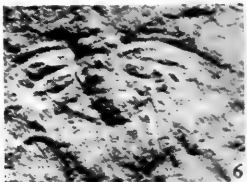
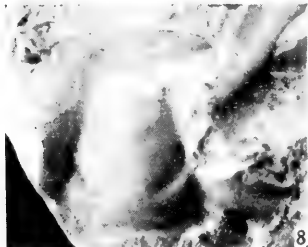
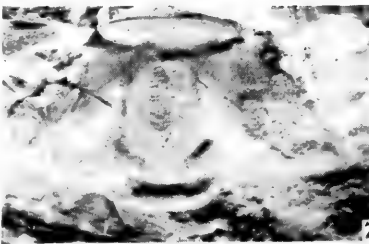
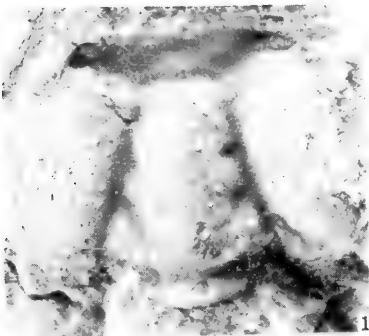
### 图 28. *Dorypygella hsihsienensis* Chu (新种)

- 头盖。×6, 正型标本。山西隰县石口镇云梦山。登记号码: 9471。

### 图 版 III

- 图 1. *Dorypygella hsihsienensis* Chu (新种)  
头盖。×6,山西隰县石口鎮云梦山。登記号碼:9472。
- 图 2 — 3. *Drepanura transversa* Chu (新种)  
2. 尾部。×5,江苏北部賈汪。登記号碼:9473。  
3. 尾部。×5,正型标本。江苏北部賈汪。登記号碼:9474。
- 图 4 — 5. *Shantungia (Parashantungia) elongata* Chu (新亚属,新种)  
4. 头盖。×4,辽宁辽阳燧台五頂山。登記号碼:9475。  
5. 头盖。×4,正型标本。辽宁辽阳燧台五頂山。登記号碼:9476。
- 图 6 — 7. *Shantungia (Metashantungia) brevicornis* Chang  
6. 头盖。×6,山东新泰南流泉。登記号碼:9477。  
7. 头盖。×5,山东崑山唐王寨。登記号碼:9478。
- 图 8 — 13. *Taitzechia wangi* Chu (新属,新种)  
8. 头盖。×3,辽宁辽阳燧台五頂山。登記号碼:9479。  
9. 头盖。×4,正型标本。辽宁辽阳燧台五頂山。登記号碼:9480。  
10. 活动頰。×4,辽宁辽阳燧台五頂山。登記号碼:9481。  
11. 活动頰。×4,辽宁辽阳燧台五頂山。登記号碼:9482。  
12. 尾部。×4,辽宁辽阳燧台五頂山。登記号碼:9483。  
13. 尾部。×4,辽宁辽阳燧台五頂山。登記号碼:9484。
- 图 14. *Taitzechia erhtaokouensis* Chu (新种)  
头盖。×4,正型标本。辽宁辽阳燧台五頂山。登記号碼:9485。
- 图 15. *Blackwelderia mui* Chu (新种)  
头盖。×3,正型标本。辽宁田师付东腰堡。登記号碼:9486。



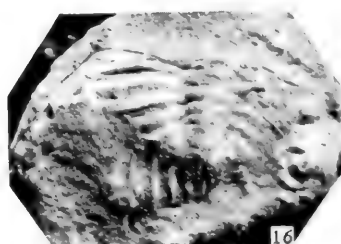
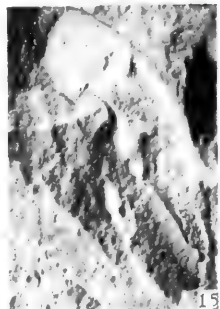
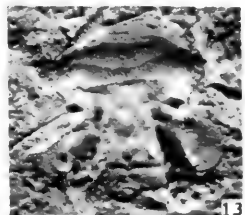
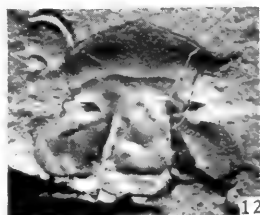
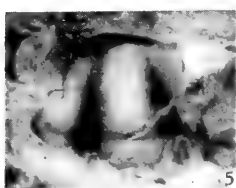
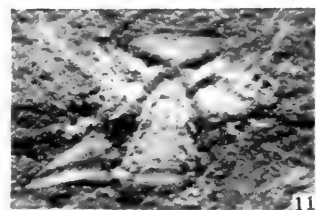
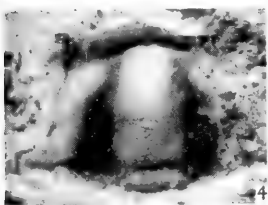
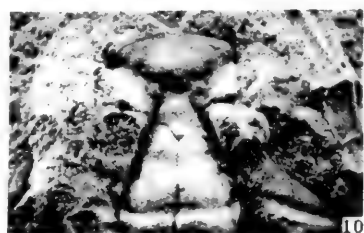
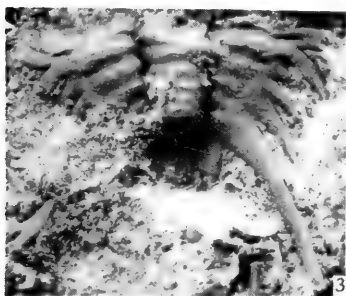
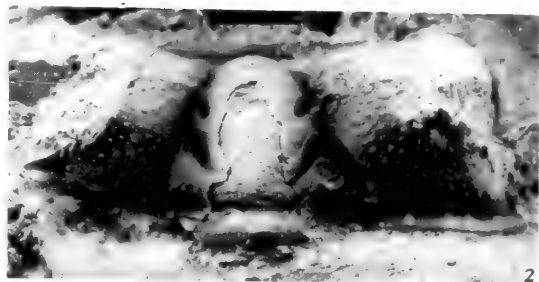


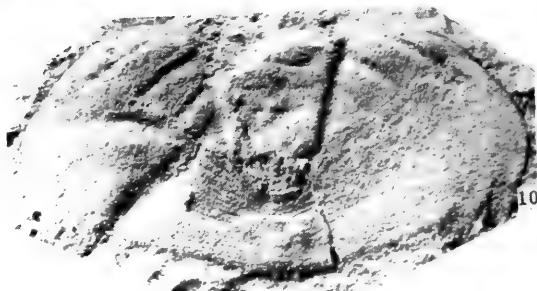
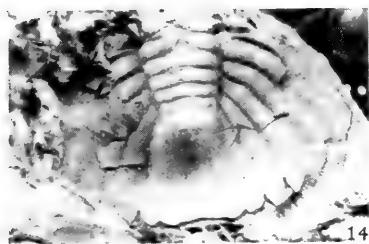
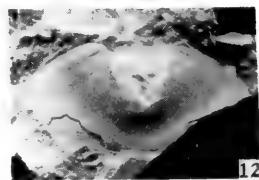
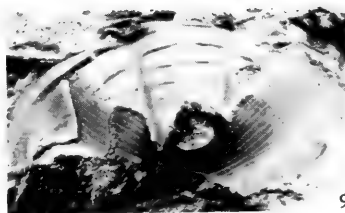
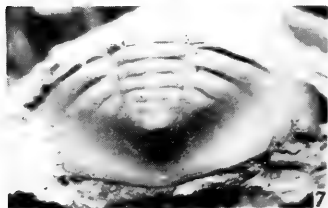
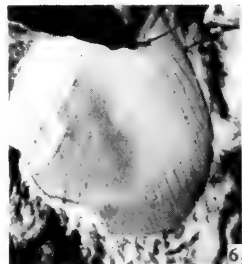
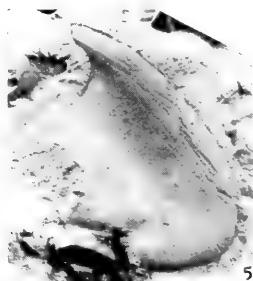
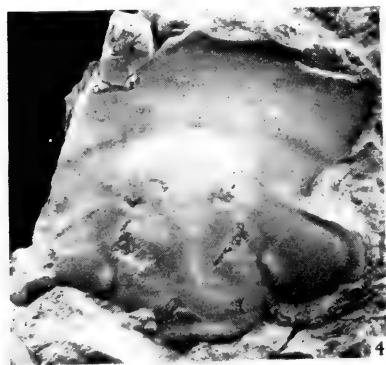
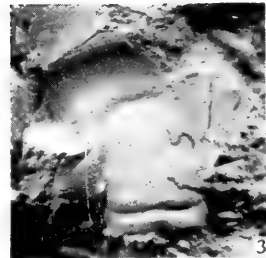
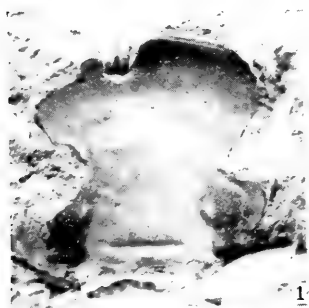
## 图 版 IV

- 图 1. *Blackwelderia liaoningensis* Chu (新种)  
头盖。×2, 正型标本。辽宁本溪营子二道沟。登记号码: 9487。
- 图 2—6. *Blackwelderia shengi* Chu (新种)  
2. 头盖。×4, 辽宁本溪营子二道沟。登记号码: 9488。  
3. 头盖。×2, 正型标本。辽宁本溪营子二道沟。登记号码: 9489。  
4. 尾部。×4, 辽宁本溪营子二道沟。登记号码: 9490。  
5. 尾部。×2, 辽宁本溪营子二道沟。登记号码: 9491。  
6. 尾部。×2, 辽宁本溪营子二道沟。登记号码: 9492。
- 图 7—10. *Blackwelderia paronai* var. *penchiensis* Chu (新变种)  
7. 头盖。×1.5, 正型标本。辽宁辽阳烟台当十岭。登记号码: 9493。  
8. 头盖。×3, 辽宁辽阳烟台当十岭。登记号码: 9494。  
9. 尾部。×2, 辽宁本溪营子北骆驼岭子。登记号码: 9495。  
10. 尾部。×2, 辽宁本溪营子北骆驼岭子。登记号码: 9496。
- 图 11—12. *Blackwelderia triangularis* Chu (新种)  
11. 尾部。×3, 河南临汝马寨。登记号码: 9497。  
12. 尾部。×3, 正型标本。河南临汝马寨。登记号码: 9498。
- 图 13. *Blackwelderia* cf. *octaspina* (Kobayashi)  
尾部。×1.5, 辽宁本溪田师付东腰堡。登记号码: 9499。
- 图 14. *Blackwelderia* (?) sp.  
尾部。×2, 辽宁辽阳烟台五顶山。登记号码: 9500。
- 图 15—16. *Stephanocare ordosensis* Chu (新种)  
15. 尾部。×3, 内蒙清水河元子湾北沟。登记号码: 9501。  
16. 尾部。×3, 正型标本。内蒙清水河元子湾北沟。登记号码: 9502。

## 图 版 V

- 图 1. *Blackwelderia chiawangensis* Chu (新种)  
 尾部。×4, 正型标本。江苏北部賈汪。登記號碼: 9503。
- 图 2 — 3. *Damesops convexus* Chu (新属, 新种)  
 2. 头盖。×3, 正型标本。江苏北部賈汪。登記號碼: 9504。  
 3. 尾部。×2, 江苏北部賈汪。登記號碼: 9505。
- 图 4 — 7. *Chiawangella pustulosa* Chu (新属, 新种)  
 4. 头盖。×4, 江苏北部賈汪。登記號碼: 9406。  
 5. 头盖。×6, 江苏北部賈汪。登記號碼: 9507。  
 6. 尾部。×4, 正型标本。江苏北部賈汪。登記號碼: 9508。  
 7. 尾部。×4, 江苏北部賈汪。登記號碼: 9509。
- 图 8 — 9. *Chiawangella pacifica* (Walcott)  
 8. 尾部。×8, 辽宁本溪田师付腰堡。登記號碼: 9510  
 9. 尾部。×6, 辽宁辽阳燧台五頂山。登記號碼: 9511
- 图 10—11. *Paramenomonie conica* Chu (新属, 新种)  
 10. 头盖。×4, 正型标本。辽宁辽阳燧台五頂山。登記號碼: 9512。  
 11. 头盖。×4, 辽宁本溪营子二道沟。登記號碼: 9513。
- 图 12—15. *Wutingshanie lui* Chu (新属, 新种)  
 12. 头盖。×3, 正型标本。辽宁辽阳燧台五頂山。登記號碼: 9514。  
 13. 头盖。×3, 辽宁辽阳燧台五頂山。登記號碼: 9515。  
 14. 活动颧。×3, 辽宁辽阳燧台五頂山。登記號碼: 9516。  
 15. 活动颧。×3, 辽宁辽阳燧台五頂山。登記號碼: 9517。
- 图 16. *Blackwelderioides monkei* (Walcott)  
 尾部。×1.5, 辽宁本溪营子二道沟。登記號碼: 9518。







## 图 版 VI

图 1—9. *Liaoningaspis taitzehoensis* Chu (新属, 新种)

1. 头盖。×2, 辽宁本溪营子东路驼岭子。登记号码: 9519。
2. 头盖。×2, 正型标本。辽宁本溪营子东路驼岭子。登记号码: 9520。
3. 头盖。×3, 辽宁辽阳烟台当十岭。登记号码: 9521。
4. 头盖。×2, 辽宁本溪营子东路驼岭子。登记号码: 9522。
5. 活动颊。×2, 辽宁本溪营子东路驼岭子。登记号码: 9523。
6. 活动颊。×3, 辽宁辽阳烟台当十岭。登记号码: 9524。
7. 尾部。×2, 辽宁本溪营子二道沟。登记号码: 9525。
8. 尾部。×2, 辽宁辽阳烟台当十岭。登记号码: 9526。
9. 尾部。×2, 辽宁本溪营子东路驼岭子。登记号码: 9527。

图 10. *Liaoningaspis* sp.

尾部。×4, 内蒙清水河。登记号码: 9528。

图 11—12. *Walcottaspidella suni* Chu (新属, 新种)

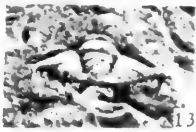
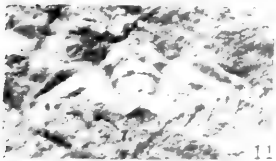
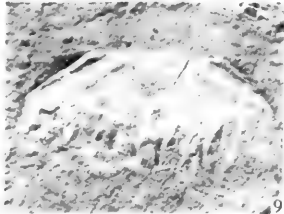
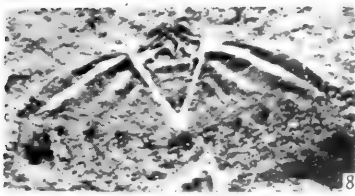
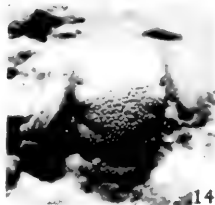
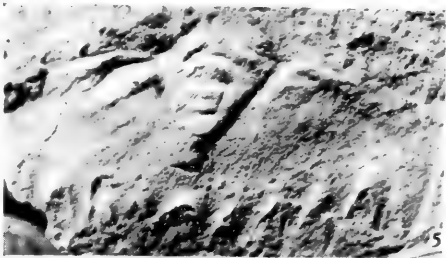
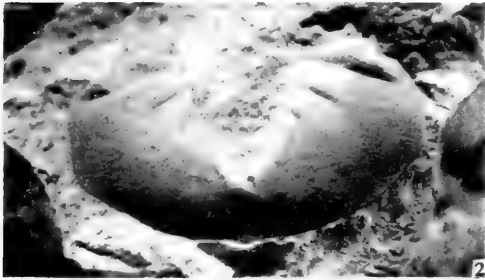
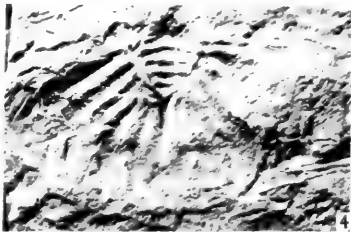
11. 头盖。×1, 正型标本。辽宁本溪田师付东腰堡。登记号码: 9529。
12. 尾部。×1, 辽宁本溪田师付东腰堡。登记号码: 9530。

图 13—14. *Kushanopyge serrata* Chu (新属, 新种)

13. 尾部。×1.5, 辽宁辽阳烟台当十岭。登记号码: 9531。
14. 尾部。×1.5, 正型标本。辽宁本溪田师付东腰堡。登记号码: 9532。

## 图 版 VII

- 图 1 — 2. *Chuangioides punctatus* Chu (新属, 新种)
1. 尾部。×6, 正型标本。山西隰县石口镇云梦山。登记号码: 9533。
  2. 尾部。×5, 山西隰县石口镇云梦山。登记号码: 9534。
- 图 3 — 4. 种属未定的 *Damesellid* 尾部 (3)
3. 尾部。×5, 辽宁本溪营子二道沟。登记号码: 9535。
  4. 尾部。×2, 辽宁本溪营子二道沟。登记号码: 9536。
- 图 5 — 8. 种属未定的 *Damesellid* 尾部 (2)
5. 尾部。×4, 辽宁本溪营子二道沟。登记号码: 9537。
  6. 尾部。×6, 辽宁本溪营子二道沟。登记号码: 9538。
  7. 尾部。×4, 辽宁本溪营子二道沟。登记号码: 9539。
  8. 尾部。×4, 辽宁辽阳烟台五顶山。登记号码: 9540。
- 图 9 — 10. 种属未定的 *Damesellid* 尾部 (4)
9. 尾部。×4, 辽宁本溪营子二道沟。登记号码: 9541。
  10. 尾部。×4, 辽宁本溪营子二道沟。登记号码: 9542。
- 图 11 — 13. 种属未定的 *Damesellid* 尾部 (1)
11. 尾部。×6, 辽宁辽阳烟台五顶山。登记号码: 9543。
  12. 尾部。×5, 辽宁辽阳烟台五顶山。登记号码: 9544。
  13. 尾部。×4, 辽宁辽阳烟台五顶山。登记号码: 9545。
- 图 14. 种属未定的 *Saukid* 头盖
- 头部。×8, 山西隰县石口镇云梦山。登记号码: 9546。
- 图 15. 种属未定的 *Saukid* 尾部
- 尾部, ×8, 江苏北部賈汪。登记号码: 9547。





## 古生物研究所集刊 (第二号)

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出版者 科学出版社  
北京朝阳门大街117号  
北京市书刊出版业营业许可出字第061号

印刷者 中国科学院印刷厂

总经售 新华书店

1959年9月第一版

书号:1875

1959年9月第一次印刷

字数:190,000

(京) 道:1-900

开本:787×1092 1/16

报:1-700

印张:8 5/8 插页:6

定价:道林本 2.00 元  
报纸本 1.55 元

42

2

统一书号: 13031·1157

定 价: 1.55 元

